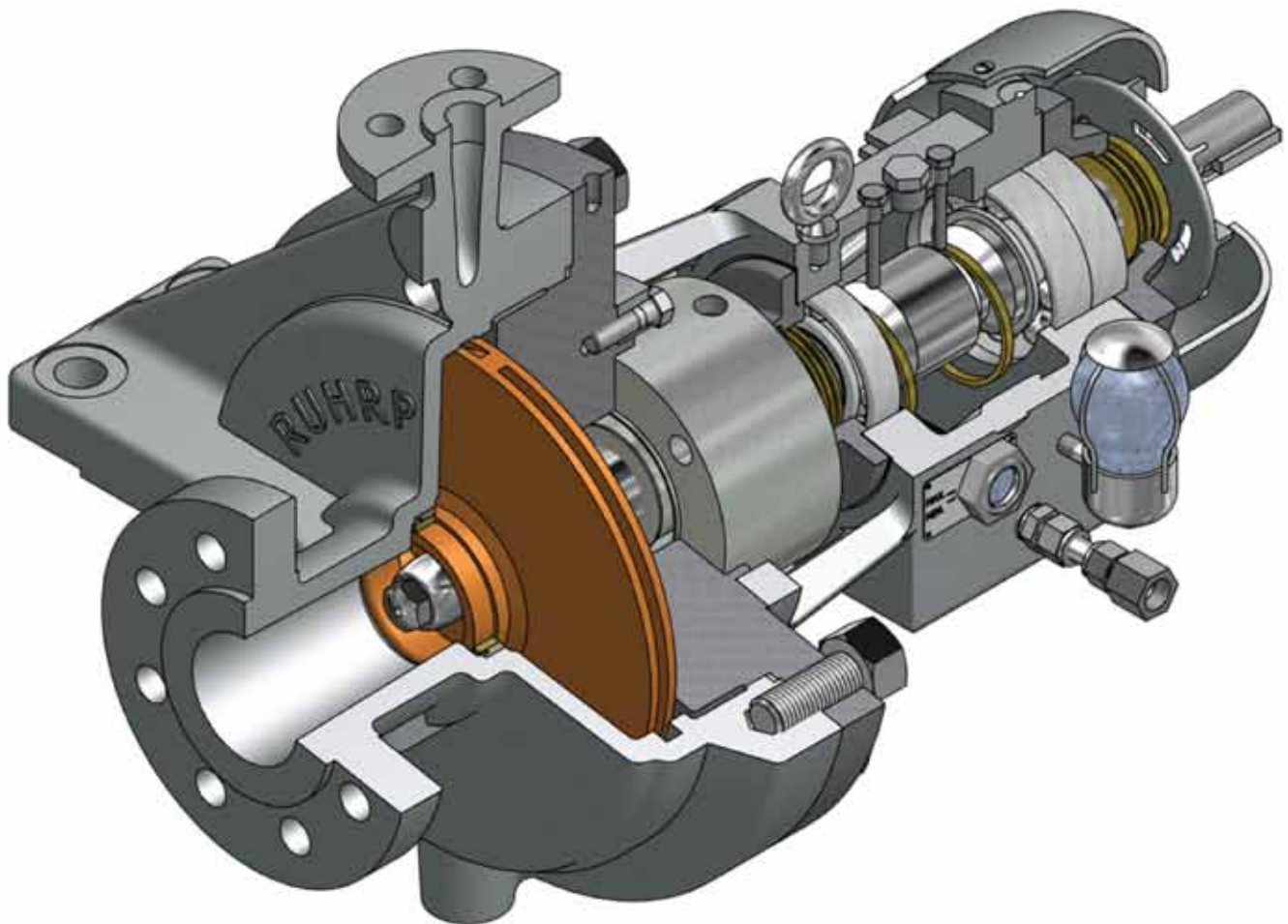




INSTALLATION, OPERATION, AND MAINTENANCE MANUAL

Renewed SCE

Heavy Duty, Single Stage, Overhung,
API 610 Process Pump



FOREWORD

These units are horizontal process pumps of the overhung bearing bracket configuration and identified by Ruhrpumpen as a Renewed or Improved SCE.

It is recommended that the services of a Ruhrpumpen installation technician be employed for the installation and initial starting of the pump. Such service will help to ensure the user that the equipment is properly installed, and will provide an excellent opportunity for the plant operator to receive useful tips and guidelines relative to the unit. The tools and/or equipment referenced in this manual are not supplied by Ruhrpumpen unless specifically ordered. This pump design can be serviced with standard maintenance tools.

Instructions in this manual are written for trained, experienced technicians who are familiar with the basic principles and tools involved in the installation, care and service of a pump and who, as part of their trade education have acquired the ability to interpret and follow the detailed specifications required for such installation, care, and service. Successful operation of the unit is dependent on careful study of the manual and a well-planned maintenance program.

A complete reading of this manual by personnel in contact with the pump is essential to safety. Incorrect installation, operation or maintenance can result in personal injury or death to personnel and damage to the pump and plant.

Before performing any service function be certain that the unit is separate from its power source or that the power source is locked out to prevent any form of energy from entering the equipment.

Contact with hot surfaces of the pump can cause severe burns. Care must be taken where such surfaces are exposed. Care must also be taken to prevent ignition of flammable fluids or other material.

Information in this manual is believed to be reliable, but it is not guaranteed by Ruhrpumpen as to its completeness or accuracy.

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SECTION ONE - PRODUCT DESCRIPTION

These operating instructions contain important information about the installation, operation and service of the unit. It is therefore imperative that the installing engineer and the responsible specialist/operating personnel read and understand these operating instructions before installation and commencement of operation.

This manual must always be available in the operational area of the machine/plant.

Please contact a Ruhrpumpen representative should problems arise. The pump may only be opened by a Ruhrpumpen approved technician during the guarantee period.

In case of queries, please have your project number and type designation of the pump available. You can find both of these on the first page of these operating instructions or on the rating plate fixed to the pump.

When ordering spare parts we would further request that you give the description of the required parts, together with their part numbers and identity numbers. You can find these on the sectional drawing and spare part list enclosed.

1.1 INTRODUCTION

Ruhrpumpen pumps of type SCE are horizontally mounted centrifugal pumps, with a vertically (radially) split case, centerline supported heavy-duty construction with an overhung impeller, and are designed to meet the requirements of the latest Edition of API 610. These pumps are designed for continuous duty pumping of various fluids with combinations of metallurgical, mechanical, and installation features for application in petroleum, petrochemical, water, and industrial product service.

The improved SCE is a single stage, single suction pump. For these pumps, rotation is clockwise as viewed from the driver (coupling) end.

A spacer coupling is provided for accessibility of service and maintenance. The spacer permits back pull-out, that is completely removable of the rotating element without disturbing the piping or driver.

The following information is included in the nameplate of your pump unit:

- Serial number
- RPM
- Head
- Capacity

Please quote the pump Serial number when ordering parts; the information in the nameplate is relevant in some sections of this manual to ensure safety operation of this pump.

1.2 PUMP CASE, IMPELLER, AND WEAR RINGS

1.2.1 Pump Case

The pump case is centerline supported. Case-to-cover fit is machined to receive a confined, controlled compression spiral wound gasket.

1.2.2 Impeller and Wear Rings

The impeller is dynamically balanced. The balancing is either single or two-plane, to meet the requirements of API610. It is keyed to the shaft and locked with an impeller nut and set screw. Replaceable front and back wear rings are standard.

1.3 SEAL CHAMBER

The seal chamber is designed to accept a wide variety of single or double mechanical seals and to comply with API 610 dimensional requirements.

1.4 BEARING BRACKET

The bearing bracket, which also serves as a large reservoir for oil ring lubrication, encloses the two ball type angular contact thrust and deep groove ball radial bearings. A radial cylindrical roller bearing is also standard for certain sizes. Each set of bearings is served by an oil ring, and oil ring retainers are provided. The bearing bracket, closed at each end by a cover and labyrinth seal, is cast with fins for air cooling but fan and water cooling are available.

BEARING TYPE	
Radial	Single-Row deep groove - Ball Single Row - Cylindrical Roller
Thrust	Two 40 degree - Angular Contact Ball bearings .

When purge or pure oil mist is specified, appropriate connections will be identified on the bearing bracket. See SECTION SIX - LUBRICATION for more details.

The fan is located at the outboard side, and the fan is guarded by a cover retained over the bearing bracket by self-tapping machine screws (unless the pump has been requested without fan).

When water cooling is specified, a cooling coil is used.

SECTION TWO - SAFETY

This operation manual gives basic instructions that should be observed during installation, operation and maintenance of the pump. It is therefore imperative that this manual be read by the responsible personnel/operator prior to assembly and commissioning. It must always be kept available at the installation site. Not only are the general safety instructions contained under this SECTION TWO - SAFETY that must be observed but also the specific information provided in other sections.

2.1 IDENTIFICATION OF SAFETY INSTRUCTIONS IN THE OPERATING MANUAL

Safety instructions given in this manual whose non-compliance would affect personal and equipment safety are identified by the following symbol.



Where electrical safety is involved, the following symbol is shown.



The **ATTENTION** symbol is inserted in safety instructions whenever non-compliance might endanger the machine or its function.

It is imperative that signs affixed to the machine are observed and kept legible, for example:

- arrow indicating the direction of rotation
- symbols indicating fluid connections

2.2 QUALIFICATION AND TRAINING OF OPERATING PERSONNEL

The personnel responsible for operation, maintenance, inspection and assembly must be adequately qualified. The responsibilities and supervision of the personnel must be exactly defined by the plant operator. If the staff does not have the necessary knowledge, they must be trained and instructed. Training may be performed by a Ruhrpumpen representative on behalf of the plant operator. Moreover, the plant operator is to make sure that the contents of the operating manual are fully understood by the personnel.

2.3 HAZARDS IN THE EVENT OF NON-COMPLIANCE WITH THE SAFETY INSTRUCTIONS

Non-compliance with the safety instructions may produce a risk to the personnel as well as to the environment and the unit and results in loss of any right to claim damages.

Non-compliance may involve the following hazards:

- Risk of injury or death.
- Failure of important functions of the machine/plant
- Exposure of people to electrical, mechanical, chemical, and thermal hazards
- Endangering or damaging the environment due to hazardous substances being released.

2.4 COMPLIANCE WITH REGULATIONS PERTAINING TO SAFETY AT WORK


When operating the pump, the safety instructions contained in this manual, the relevant national accident prevention regulations, local and federal health and safety regulations, quality system requirements, and any other service and safety instructions issued by the plant operator must be observed.

2.5 COMPLIANCE WITH DIRECTIVES PERTAINING TO PUMPS OPERATING IN POTENTIALLY EXPLOSIVE ATMOSPHERES

This pump line is designed to meet group II, category 2 G in the ATEX classification. The marking of the pump classified according to the ATEX directive is as follows:



Where:

-  is the Ex marking, which indicates compliance with ATEX under the conditions specified by the nomenclature when used together with the CE marking.
- II is Group II according to directive 94/9/EC, corresponding to a non-mining product.
- 2 is the specific category within Group II, indicating that the pump is suitable to work in Zones 1 and 2. In Zone 1, explosive atmospheres are likely to occur occasionally, and in Zone 2, explosive atmospheres are not likely to happen and if so, they occur over a short period.
- G stands for Gas, indicating that the safety specified in the category is ensured in an atmosphere where gas is the potential explosive.
- c is the explosion protection by constructional safety according to EN-13463-5

- X is the spacer for temperature, because in a pump, according to EN 13463-1, the surface temperature is a dependent variable of the temperature of the liquid pumped. Verify the temperature range of operation applicable to your pump.



- It is important to exercise caution when operating the pump under a potentially explosive atmosphere. Especially important is to keep the pump clean and free of dirt or other accumulating debris that might add friction to the moving parts of the pump, increasing the temperature and the risk to generate sparks.

2.6 SAFETY INSTRUCTIONS RELEVANT FOR OPERATION



- If hot or cold machine components involve hazards, they must be guarded against accidental contact (attach warning signs).



- Guards for moving parts (e.g. coupling) must not be removed from the machine while in operation (mounting must be possible only with tools) .



- Any leakage of hazardous fluids must be drained away to prevent any risk to persons or the environment. Statutory regulations are to be complied with.



- Hazards resulting from electricity must be prevented.

2.7 SAFETY INSTRUCTIONS RELEVANT FOR MAINTENANCE, INSPECTION AND ASSEMBLY WORK

It is the plant operator's responsibility to ensure that all maintenance, inspection and assembly work is performed by authorized and qualified personnel who have adequately familiarized themselves with the subject in matter by studying this manual in detail.

Any work on the machine shall only be performed when it is at a standstill. To shut off the machine it is imperative to follow the procedure for shutting down the machine as described in SECTION 7.5 - STOPPING.

Pumps and pump units that convey hazardous materials must be decontaminated before any maintenance work is performed.

On completion of work all safety and protective facilities must be re-installed and made operative again.

Prior to restarting the machine, follow the instructions listed under SECTION 7.2 - STARTUP.

2.8 UNAUTHORIZED ALTERATIONS AND SPARE PARTS

Modifications may be made to the machine only after consultation with a Ruhrpumpen representative.

Using spare parts and accessories authorized by Ruhrpumpen is in the interest of safety. The use of parts not authorized by the dealer exempt the manufacturer from any liability, voiding the warranty.

2.9 UNAUTHORIZED MODES OF OPERATION

The reliability of the machine is guaranteed if and only if it is used in the intended manner, in accordance with the statutes of this manual. The limit values specified in the data sheet must never be exceeded under any circumstance.

SECTION THREE - TRANSPORT & STORAGE

3.1 SHIPPING ARRANGEMENTS

The pump, coupling hub, and driver are generally shipped mounted on the baseplate.

A wooden skid is furnished for support and ease of transportation. Other required items (e.g. coupling, hardware, spare parts, etc.) are boxed or secured to the skid.

3.2 UNLOADING AND CHECKING EQUIPMENT

The following steps should be completed for all pumps when received.

1. Handle all equipment carefully.
2. Remove unit only by properly supporting the wooden shipping skid.
3. After unloading, inspect the pump, check the shipment against the packing list, and report damages or shortages immediately to freight carrier and to the designated Ruhrpumpen representative.



- Do not place lifting rig around bearing bracket or under baseplate. Do not use the eyebolt at the top of pump and bearing bracket to lift unit.

3.3 TRANSPORT



- To avoid damage, the unit must be transported and handled with care. It should be gently lowered onto an even surface. Pay attention to and identify the signs marking the points of equilibrium and fastening places for ropes, or the openings for forklift trucks.



- Observe the plant's safety precautions when lifting heavy components.



- When transporting with a crane, the rope should be slung round the unit as shown below in Figure 3.1.



- The rope should not be slung around the lugs attached to the motor or around the lugs attached to the pump.

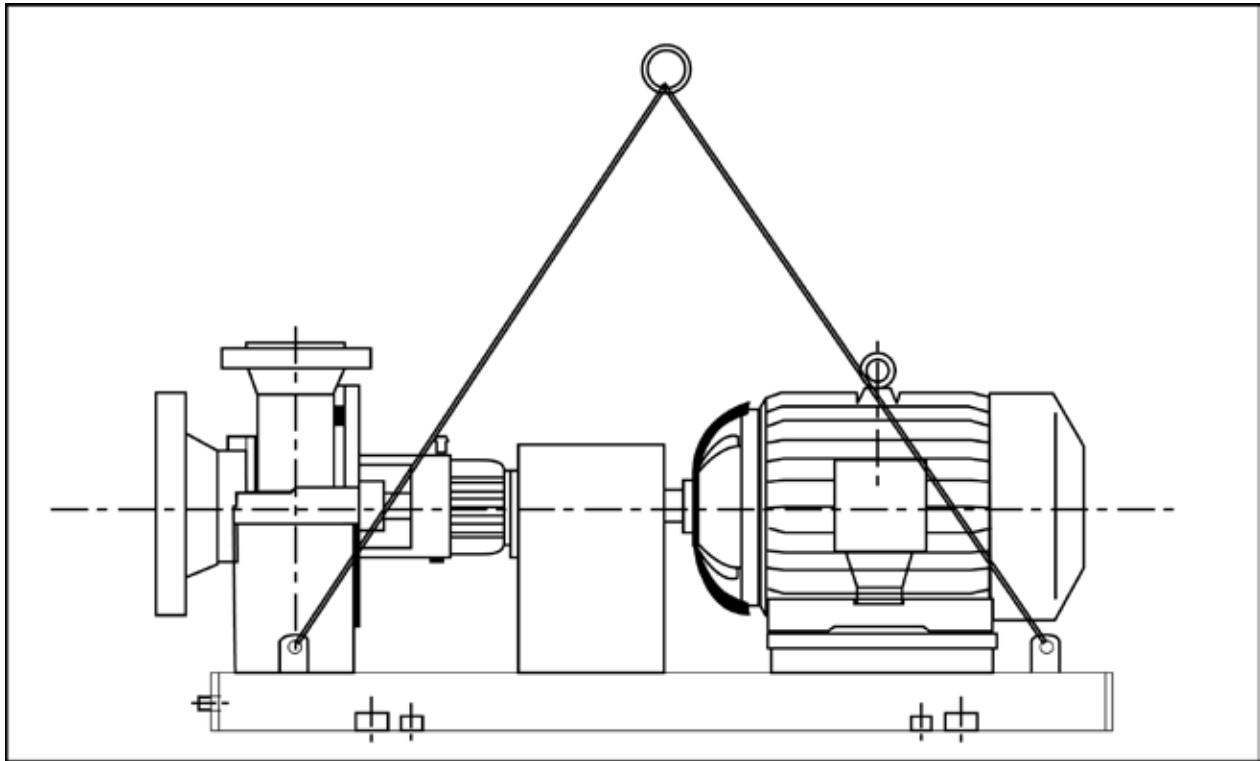


Figure 3.1 Correct Position of the lifting ropes or chains.

3.4 STORING

If the pump is not installed immediately (within one month after shipping date), it should be safely stored prior to installation in a dry location free of dirt and grit. Furthermore, the pump unit (pump, driver, etc.) should not be subject to sudden temperature changes or vibrations.

Observe the following steps:

1. Remove pump from shipping crate, but do not damage the crate because the unit is to be reboxed.
2. Remove all instruments and mechanical seal; store them safely.
3. Plug the instrument taps.
4. Thoroughly dry the pump with hot air.
5. Any painted surface damaged in shipment should be repainted or sprayed with oil.
6. Keep the pump moisture-free by the following two means:
 - a. Spray the pump case, bearing housing with acid-free, moisture-free, protective oil or kerosene.
 - b. Place desiccant or humidior bags inside the suction and discharge areas of the pump.



- Attach red tags with a “Remove Moisture Absorbent Material Bags Prior to Installing” to warn about the presence of this desiccant material.

7. Cover all the openings with plywood or metal covers. Recheck the condition of these covers every month and replace as necessary.
8. If the pump’s external parts have protective coatings, periodically inspect and renew the coating as required.
9. Rotate the shaft 1 ¼ revolutions every week. Lubricate shaft bearings prior to rotation.



- The client must keep a record of the weekly rotation of the shaft. Failure to document and present these records as evidence will void the warranty.

10. Check the packaging for damage every month.
11. Ensure pump flange covers remain in place.
12. Return the unit to the shipping crate.
13. When the pump is to be installed, remove all the protective coatings and desiccant or drain all oils.

One month before installation, a Ruhrpumpen representative should be employed to conduct a final inspection.

To properly store the motor (driver) for periods longer than one month, follow these steps:

1. Store the motor in a clean, dry area, or cover it with a loose tarp (the tarp must be loose in order to prevent condensation).
2. Exercise precautions to avoid transit or nesting of rodents, snakes, birds, and insects.
3. Inspect and, if necessary, recoat the rust preventive coating of external machined surfaces.
4. Fill with lubricant the grease-lubricated cavities of the motor, but first remove the drain plug and fill the cavity until the grease starts to purge.



- Follow the instruction manual of the driver manufacturer to ensure the lubrication is performed properly.

5. Upon receipt, considering that the oil-lubricated drivers are not shipped oil-filled, fill the reservoir to maximum level with properly selected oil with rust and corrosion inhibitors.



- Always drain the oil before moving the pump, to avoid any damages, and refill the motor on its new location.

6. Rotate the shaft of the motor once a month
7. Some form of heating must be used to prevent condensation. This heating should maintain the winding temperature at a minimum of 9 °F (5 °C) above the surrounding ambient temperature. There are three options:
 - If space heaters are supplied, they should be energized.
 - If none is available, single phase or “trickle” heating may be utilized by energizing one phase of the motor’s windings with a low voltage, producing heat in the winding conductor.



- Request the required voltage and transformer capacity from the driver manufacturer.
- A third option is to use an auxiliary heat source and keep the windings warm by either convection or blowing warm dry air into the motor.



- Be careful not to overheat, since keeping the temperature of the motor frame 9 °F (5 °C) above the surrounding ambient temperature is sufficient.

After the storing period, follow the next steps as start-up preparations:

1. Motor should be thoroughly inspected and cleaned to restore to an “As Shipped” condition.
2. Motors, which have been subjected to vibration, must be disassembled and each bearing inspected for damage.
3. Oil and/or grease must be completely changed using lubricants and methods recommended on the motor’s lubrication plate, in the “LUBRICATION” section of the driver manufacturer’s manual.
4. If storage has exceeded one year, the motor manufacturer’s Quality Assurance Department must be contacted prior to equipment start-up for any special recommendations.

3.5 CONSERVATION

All exposed, machined, working surfaces (flanges, seals, surfaces supporting the motor), shaft ends, unpainted couplings and the like have been cleaned and treated with anticorrosive agents. After being cleaned, all parts inside the pump housing have been sprayed with anticorrosive agents.

The period of protection offered by these conservation measures is approximately 18 months if stored in a dry place. If stored under unfavorable climatic conditions, this protective period may be considerably reduced. Should the anticorrosive layer become damaged, it can be repaired by repainting or respraying.



- Anticorrosive layers inside the pump housing must be removed with process neutral solvents before commencing pump operation.



- When removing the protective coating with a neutral solvent, follow the safety instructions of the solvent manufacturer carefully.



- The anticorrosive layer applied to the exposed parts does not need to be removed before putting the pump into operation.

SECTION FOUR - INSTALLATION

Correct and orderly installation/assembly is necessary for trouble-free operation of the unit. Ruhrpumpen does not assume any liability for damage resulting from inadequate installation/assembly. The chosen location for installation must offer enough space for maintenance activities. Consult also API Recommended Practice 686 to ensure proper installation in your facility.

4.1 CONCRETE FOUNDATION PREPARATION

1. Choose a solid ground location for foundation; check that the bearing capacity of the soil is at least one third higher than both static and dynamic loads together.
2. The effects of vibrating equipment on the surrounding area should be investigated and the isolation required for the foundation should be considered. It is important to consider that the driver and the driven machinery must be supported from a common foundation.



- A minimum compressive strength of 4061 psi (28 MPa) for the concrete is to be reached after 30 days. Check with your supplier the strength and time of setting.



- All foundation materials shall be selected to prevent deterioration due to exposure to an aggressive environment; the use of a protective coating should be considered.



- The mass of the concrete foundation should be five (5) to ten (10) times the mass of the supported equipment.



- Imaginary lines extended downward 30 degrees to either side of a vertical line through the pump shaft should pass through the bottom of the foundation and not the sides, as shown in Figure 4.1.

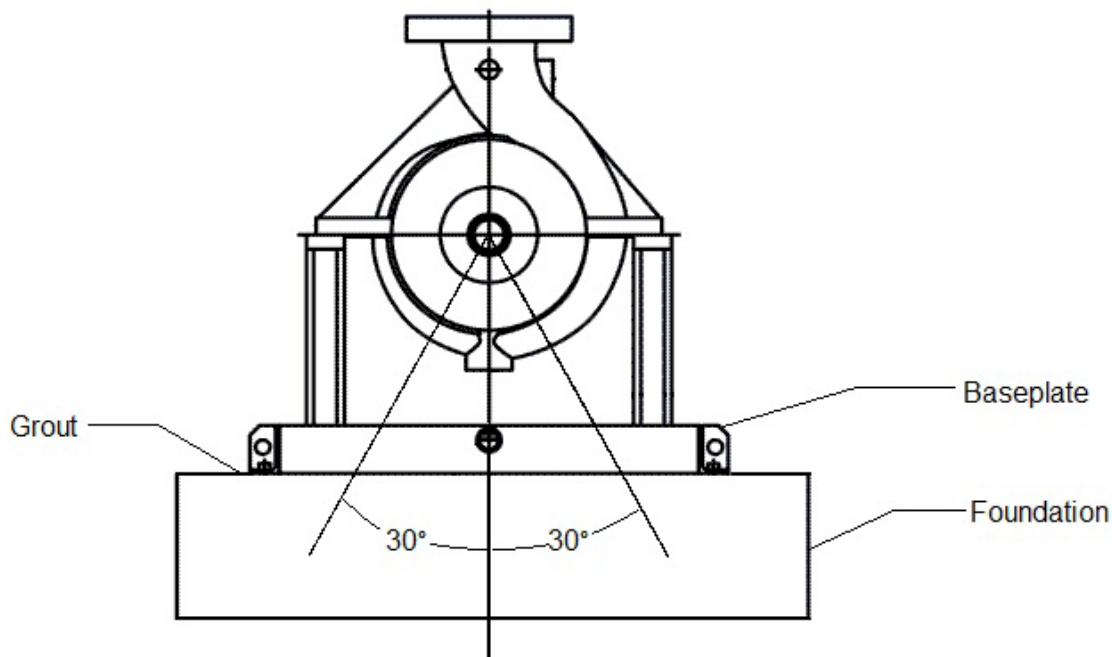


Figure 4.1 Imaginary lines.

3. Build foundation approximately 3 inches (76 mm) larger overall than the pump baseplate for machines up to 500 horsepower (372 kW), and 6 inches (152 mm) larger for machines greater than 500 horsepower (372 kW) to provide ample anchorage for the foundation bolts.
 - 3.1. Since water can accidentally flow in the floor, a height for the surface of the foundation of 4 inches (100 mm) at least above floor level is recommended.
4. Use a template to accurately locate foundation bolts according to the General Arrangement.
 - 4.1. Choose foundation bolts of size specified in drawing (ASTM A36, M 1020 and ASTM A575 are recommended), they should be long enough to allow a minimum of two threads above the nuts.
5. Provide pipe enclosures for the bolts, which are three or four diameters larger than the bolts.
6. Protect area around the bolts from contact with the concrete.
7. Pour the concrete and provide a chamfer at all corners.
8. Allow concrete to cure completely (at least seven days) before preparing the surface for grout preparation.

4.2 LEVELING BASEPLATE

Before leveling the unit onto the foundation, the following preparations must be made:

1. Chip away all damaged concrete with a hammer and chisel, eliminating about one inch of the surface of the foundation. After surface chipping is done, the foundation shall be thoroughly cleaned

free of debris. Clean the anchor holes.

2. Check that the placement and dimensions of the foundation and the anchor holes correspond to the assembly plan.

The foundation must be kept free of all contamination after it has been prepared for grouting.

To continue with the leveling procedure:

1. Remove the pump and driver from the base to facilitate the leveling procedure.
2. Remove baseplate from wooden skid.
3. Attach lifting rig hooks to lifting lugs of baseplate as described in SECTION 3.3 - TRANSPORT.
4. Guide baseplate to position above foundation bolts and lower baseplate into position over foundation bolts; be sure to respect the above-mentioned clearance between concrete and baseplate.



- There should be a minimum annular clearance of 1/8 inch (3 mm) between anchor bolt holes and the anchor bolts to allow for field alignments



- Exercise proper caution when working under or around suspended objects.

5. Using a precision level across baseplate pads, adjust jacking bolts as necessary to ensure that baseplate is level in all directions (See Figure 4.2), within 0.002 in/ft (0.2 mm/m).

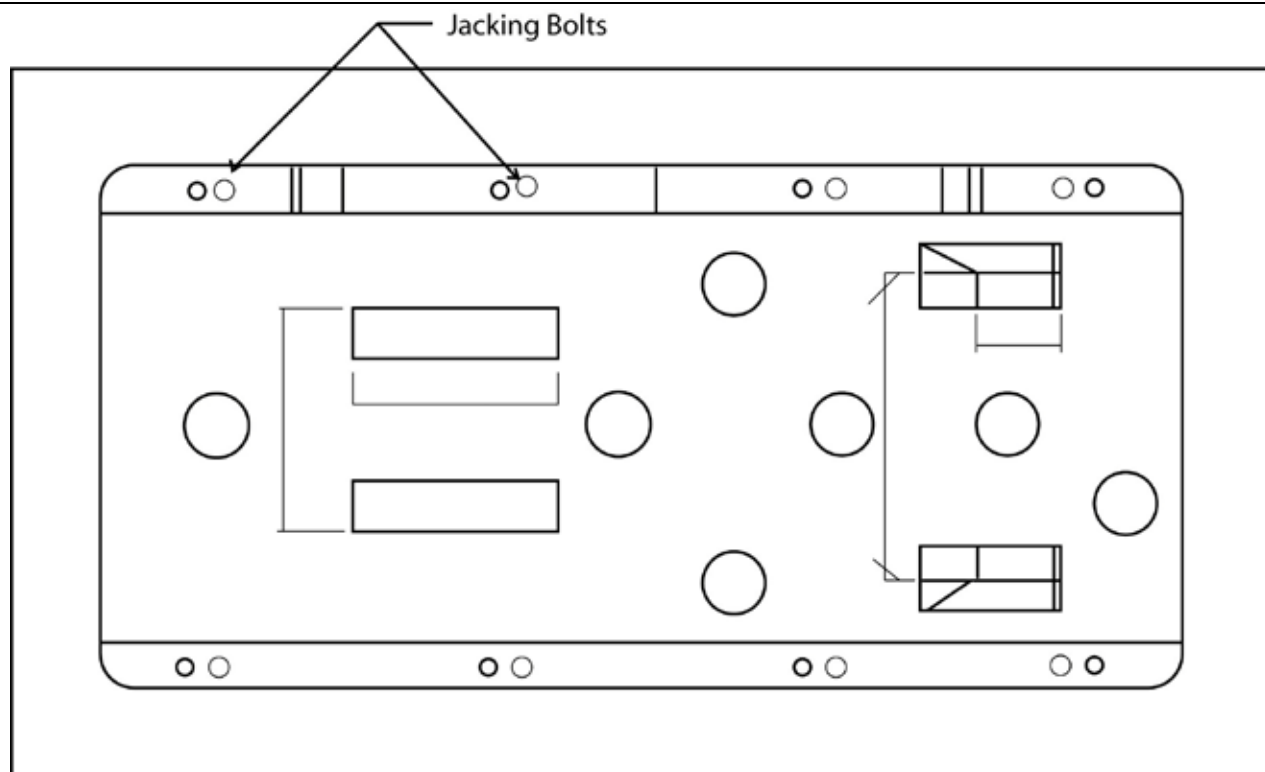


Figure 4.2 Baseplate leveling planes.



- The alignment of the base plate is effected only with the help of adjusting screws. Wedges may not be used for this purpose.



- NOTE: Each jacking bolt should have a mounting pad, to distribute the stresses evenly.



- NOTE: The baseplate should be mounted without distortion. Under no circumstances should the driver be higher than the pump.

7. When baseplate is level, 'snug' the foundation bolt nuts, but do not tighten completely.

4.3 GROUTING

4.3.1 Equipment/Material Required

- Grout Mix: Non Shrink Type
- Sufficient lumber for foundation template and grout trough.

- Risers or funnels for guiding grout.
- Sufficient oil paint for grout protective covering.
- Dial indicator.
- One bracket, suitably stiff having an arm length of sufficient length to extend from the driver coupling hub to the pump coupling hub.

4.3.2 Grouting Precautions

During all the grouting process, the involved personnel must follow these safety precautions:

1. Wear goggles or face shields, aprons, and protective gloves at all times.
2. Wear dust masks if in contact with the dry aggregates.
3. Wash hands regularly with soap and water.



- Some epoxy grouts have highly exothermic reactive properties; they should be handled with care. They may become extremely hot and cause severe burns.

4.3.3 Grouting Procedure

1. Verify that anchored bolt sleeves are clean and dry. Fill them with a nonbonding moldable material to prevent them from being grouted.
2. The anchor bolt threads should be protected with tape before grouting.
3. Provide a form around the baseplate to contain the grout. The form should be chamfered at all corners.



- Grout forms should be attached with drilled anchors. Do not power nail.



- Apply three coats of paste wax to the inside surfaces of the forms in order to prevent adherence. Do not use oil or liquid wax.



- Prevent grout leakage, as leaks will not self-seal.

Apply the grout, starting at one end of the form and advancing toward the other end. The use of push tools to get rid of trapped air is allowed if done in long strokes.



- Do not vibrate or violently ram the grout (it may cause the aggregates to separate).



- Do not plug any baseplate fill or vent holes until the grout has set to avoid baseplate distortion.



- Check with the supplier of the grout the preferred thickness for your installation.

4. Tap baseplate to eliminate air pockets.



- It is imperative to get rid of all trapped air before the grout hardens.



- Check frequently for grout leaks.



- Leaks will not self-seal and may cause voids.

5. Remove jackscrews and grout-forms once the grout has completely hardened (takes around 3 days).
6. Do not use grout to fill the jackscrew's holes; use a sealant material instead.
7. Tighten the foundation bolts with an appropriate torque value. In case of doubt, please contact your Ruhrpumpen representative.
8. Apply oil paint to exposed grout to protect from air and moisture.
9. Use a lifting rig to position the pump and driver on their baseplate so that the mounting feet line up with their respective tapped holes.
10. Fasten the pump and driver hold down bolts, attach all auxiliary piping and wiring.

SECTION FIVE - PIPING AND ALIGNMENT



- These units are furnished for a specific service condition. Any change in the hydraulic system may affect the pump performance adversely.



- The connection of the piping must be carried out with utmost care; otherwise, the pumping medium can escape during operation, which can seriously endanger the operating personnel.



- Do not start the piping and alignment procedures until grouting, preliminary alignment (as seen in the previous sections of this manual) and on site welding have been performed.



- In a new installation, great care should be taken to prevent dirt, scale, welding beads, and other items from entering the pump. The suction system should be thoroughly flushed before installing the suction strainer and suction piping.



- Suction and discharge piping should be of ample size, be installed in direct runs with minimum bends.



- Short radius elbows shall be avoided near the suction nozzle. If an elbow is necessary, it should be of the long radius type.



- Suction and discharge piping configurations should be in accordance with the Hydraulic Institute Standards.



- Suction and discharge piping, fittings, and valves must be adequately supported and anchored close to the pump flanges to eliminate strains imposed on the pump casing, prevent excessive nozzle loads, maintain pump/driver alignment, and avoid pipe-induced vibration.

5.1 PIPING THE SYSTEM

1. Check whether the piping is loosely laid, so that no strain is placed on the pump.



- Piping layout and installation shall provide adequate maintenance and operation accessibility. Field installed auxiliary equipment shall not interfere with removal of the machine or driver.

2. Remove the covers of the pump flanges.
3. Check whether the seals are correctly mounted.
4. Install a check valve and a gate valve in the discharge pipe. When the pump is stopped, the check valve will protect the pump against excessive back-flow pressure and will prevent the pump from running backward.



- The check valve should be installed between the gate valve and discharge flange in order to permit its inspection.

5. A spool piece should be installed in suction line so that the suction strainer may be installed and removed with a pressure gauge between the strainer and pump.
6. The suction strainer should be installed between 5 to 20 pipe diameters upstream from the suction flange.
7. Cone type strainers (otherwise known as “witches –hat” strainers) should be mounted as recommended within the Hydraulic Institute, with the cone pointing upstream away from the pump, into the oncoming flow. As the strainer gradually gathers particles from the liquid and blocks up, this direction will result in the lowest turbulence impact onto the liquid flow entering the pump.
8. Disconnect the piping from the pump if you heat one side of the pipe to align the pipe to the pump.
9. Pump and pipe flanges must be parallel; they should mate together without effort, and with the bolt holes properly in line.
10. Check the fine alignment by clocking or using a Dial Type Indicator (DTI) on the coupling. Check the operating instruction for the coupling.
11. Connect and tighten the suction pipe and compare the alignment with the values of the fine alignment. In the case of deviations, warm the pipe so that the values of the fine alignment are reached.



- When heating takes place close to the flange, there is a danger that the flange seal will become rippled and leaky. No more welding work can be carried out on the piping when it is screwed to the pump.

12. Proceed in the same way with the discharge pipe.



- Make sure that there are isolation block valves at the pump for each type of auxiliary piping.



- Consider a slope in the suction piping to avoid high points.



- In horizontal suction lines, reducers should be eccentric (with the flat side of the reducer on top).



- No obstruction within at least five pipe diameters of the suction flange should be fitted



- Do not install unsupported piping on the pump.



- Make sure electrical connections do not impose any stress on the pump unit



- Remember that the pump must not be moved once the baseplate has been set: the piping (both suction and discharge) is the one aligned to the pump.



- When aligning, all the elements to be aligned (including the pipes) should be at the same temperature (ambient).



- It is important to confirm that the pump can be moved out from the baseplate without cutting or welding (only by adjusting connections and flanges).



- Do not use drifts or cheater bars to force alignment of bolt holes – serious damage to the pump will result.

5.2 ALIGNMENT*

In the following pages, alignment procedures are explained with dial indicators. Laser alignment is also possible. The specific method in laser alignment will depend on the manufacturer's instructions; however, the basic principles and rotation of the shafts apply, as in the Reverse Indicator Alignment Method. Therefore, for laser alignment, you may follow the steps detailed on the next pages, mounting a laser bracket with a measurement device on each shaft and then proceed with the rotation of the shafts to obtain the readings to determine the misalignment and correct it.

NOTE: The pump case has centerline support feet integrally cast with the case for equal thermal expansion or contraction. This minimizes alignment problems caused by case movement due to temperature conditions between operating and ambient conditions and thus negates the need for "hot" alignment, except for the highest operating temperatures.

A. ALIGNMENT OF EQUIPMENT

Correct alignment is mandatory for the successful operation of rotating equipment. A flexible coupling is no excuse for misalignment. The relationship between shaft centerlines can easily be determined by 1) two step dial indicator method, 2) reverse indicator alignment, 3) across the disc pack alignment. These can all be solved by a graphical approach. This procedure will discuss methods 2 and 3. Method 1 is covered in Rexnord's Manual MT-SS-04-001, "Two Step Dial Indicator Method". Before we get into this alignment procedure, several items should be considered at this point.

1. Indicator Set-Up

No matter what arrangement you use, indicator sag must be determined. This can easily be determined by clamping the set-up onto a rigid piece of pipe, rolling the indicator from top to bottom, and reading the difference. Once the indicator sag set-up has been determined, this number can be algebraically subtracted from the alignment readings obtain at the bottom. There is no need to be concerned about the side to side readings as the sag is equal on both sides.

2. Taking Alignment Readings

It is suggested that the dial indicator be zeroed at the top. For convenience, you should mark your coupling at 0°, 90°, 180°, and 270° with a reference mark on the case so that you can be sure to turn the unit exactly 90°. Both shafts should be turned an equal amount if the coupling is not put together. Now rotate the coupling in 90° increments recording all readings. It is important to keep your side to side readings straight. A suggestion is to show compass orientation so that you know which reading to use. After you have made your four position check and have returned back to the top, it is absolutely necessary that the indicator return to zero where it started. If it did not, repeat your readings. It is also advisable to check the readings several times to make sure that they are repeatable.

3. Thermal Growth

If there are thermal growth considerations on the piece of equipment, it is a good idea to get these numbers so

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that they can be added to or subtracted from the graphical solution before the equipment move is made, this is known as “Hot alignment”.

4. Soft Foot

The fact that your equipment could have a soft foot can affect the alignment readings that you obtain. The soft foot should be checked first and eliminated. This can easily be done by mounting a dial indicator on the base plate indicating off the top of foot on the machine to be checked. Each foot in rotation is then checked by loosening only the bolt with the rest of the bolts being tight. A soft foot check should be carried out when the unit is stationary for safety reasons, and should be carried out on whole drive train. It should never be necessary to shim under the pump mounting feet. Soft foot issues could indicate excessive piping loads transmitted to the pump, or that the baseplate has been twisted, and is not grouted and mounted flat.

B. REVERSE INDICATOR ALIGNMENT GRAPHICAL ANALYSIS

On a sheet of graph paper, lay out the equipment that you are trying to align. You should use a scale that is convenient to the size of the graph paper. The distances that are critical are:

1. Distance from where the first indicator rides on the pump hub to where the second indicator rides on the motor hub. In the example shown below, this is 10-1/2 inches (266.7 mm).
2. Distance from where the second indicator rides on the motor hub to the center of the front motor feet. In the example below, this is 2-1/2 inches (63.5 mm).
3. Distance from the center of the motor front feet to the center of the motor back feet. In the example shown below, this is 5-1/4 inches (133.4 mm).

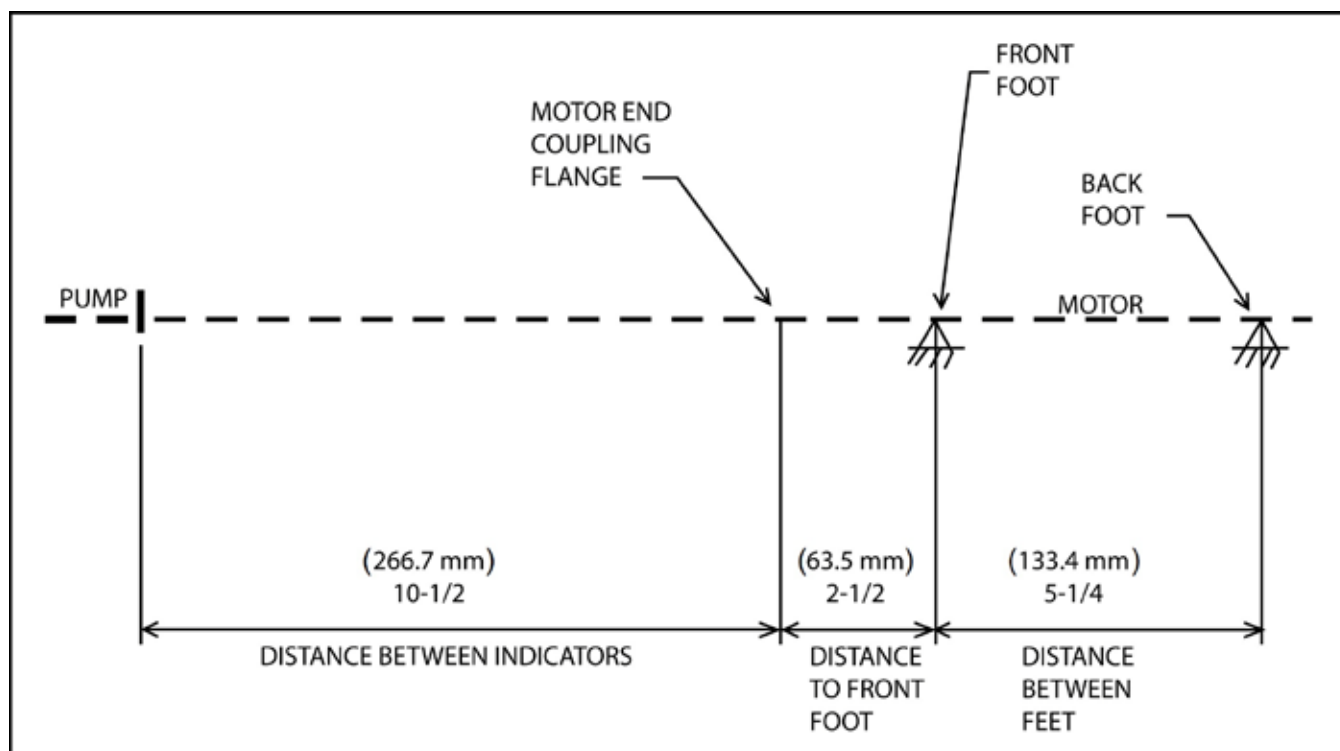


Figure 5.1 Example for reverse indicator graphical analysis.

The next step is to determine indicator sag. Set up your bracket arrangement on a pipe. Set the indicator at '0' on top. Roll set up until indicator is at the bottom of pipe. It will read negative. In this example, it is found to be -0.005 inch (-0.127 mm).

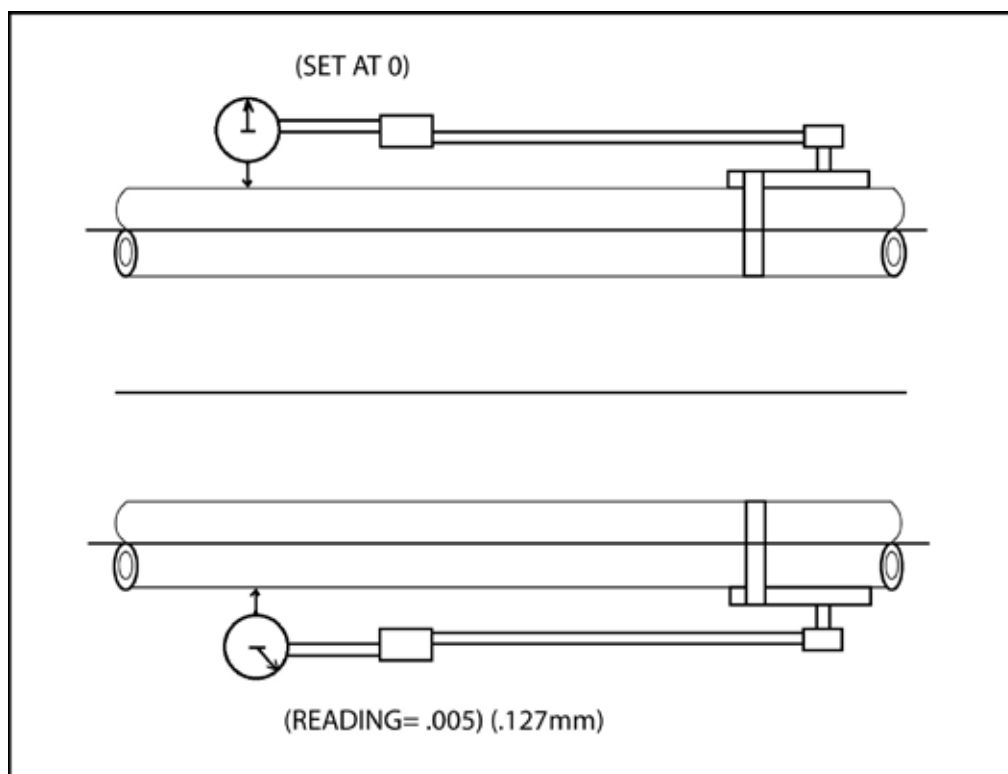


Figure 5.2 Indicator sag.

With the indicator bracket attached to the motor hub reading off the pump hub, rotate unit in 90° increments and take readings.

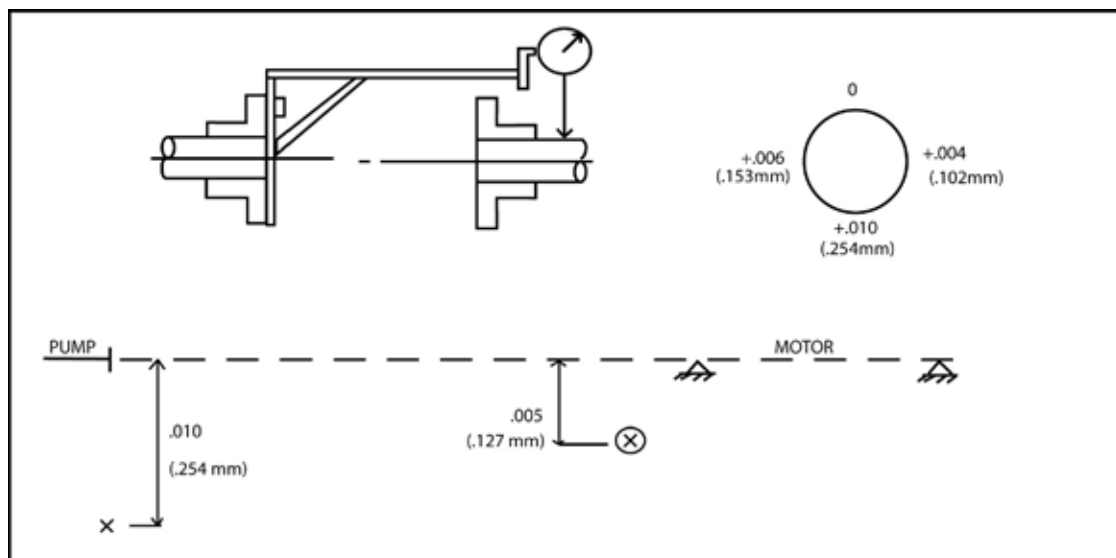
Bottom reading is then corrected for indicator sag. Indicator sag in the example was determined to be 0.005 inch (0.127 mm). The -0.005 inch (-0.127 mm) was subtracted from the -0.025 inch (-0.639 mm) indicator reading to give an actual -0.020 inch (-0.508 mm) reading.

As this is a TIR (Total Indicator Readout) it is two times the actual shaft to shaft rotation 0.020 inch (0.508 mm)/ 2 inch (50.8 mm) or 0.010 inch (0.254 mm) is used to show where the motor shaft extension is relative to the pump shaft center line at the hub. Minus at the bottom indicated motor shaft extension is low compared to the pump. Using a scale of one small division on the graph equals 0.001 inch (0.0254 mm); plot this point as show in the example.

Now with the indicator bracket attached to the pump hub reading off the motor hub, rotate unit again in 90° increments. NOTE: If you can set up both indicators at once, both sets of readings can be taken at one time.

The +0.010 inch (+0.254 mm) is divided by two to give +0.005 inch (+0.127 mm) which is the actual shaft extension to shaft relationship.

In this case, a plus reading at the bottom indicates the motor shaft is low compared to the pump shaft extension. Plot this point as shown in the example.



We have now located the motor shaft theoretical extension in two places:

- A. In the plane of the pump hub.

B. In the plane of the motor hub.

Drawing a straight line through these two points crossing the plane of the two motor feet. The shim adjustment can now be read directly off the graph. In this example, 0.004 inch (0.102 mm) should be added to the front foot and 0.001 inch (0.025 mm) should be added to the back foot.

This solution can also be done by the use of pre-programmed, hand calculators for faster results.

For the horizontal (side to side) results, the same procedure is used. Algebraically subtract the side to side readings. Indicator sag can be ignored as it cancels out. Plot these readings and the results can be read off the graph plot.

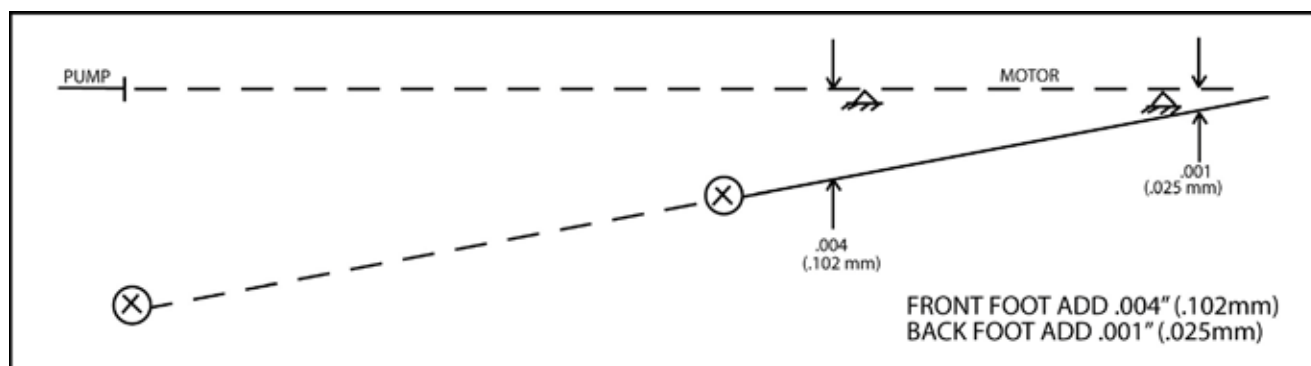


Figure 5.5 Final graph plot for reverse indicator alignment graphical analysis.

C. REVERSE INDICATOR ALIGNMENT MORE THAN TWO UNITS GRAPHICAL ANALYSIS

This method lends itself very well in solving alignment problems of three or more pieces of equipment in a line.

To solve this problem, follow the steps already outlined for each coupling in the train. Plot the shaft to shaft relationship of each set of shafts. Look at the total picture. In this example, a line was drawn through the average of all points plotted. The units were then aligned to this mean line.

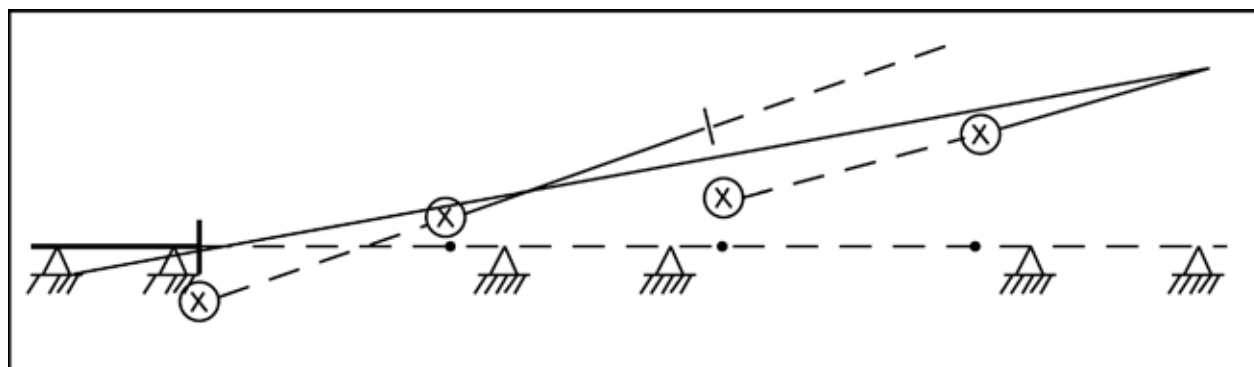


Figure 5.6 Reverse indicator alignment of more than two units.

D. ACROSS THE DISC PACK ALIGNMENT GRAPHICAL ANALYSIS

When the distance between disc packs is long where it is not practical to try to span the distance with indicator bracketry, the 'across the disc pack method' can be used.

On a sheet of graph paper, lay out the equipment that you are trying to align. You should use a scale that is

convenient to the size of the graph paper. The distances that are critical are:

1. Distance from centerline of one disc pack to the centerline of the other disc pack. In the example, it is 9-1/2 inches (241.3 mm).
2. Distance from centerline of motor disc pack to center of front motor foot. In this example, it is 3 inches (76.2 mm).
3. Distance from the center of the motor front feet to the center of the motor back feet. In this example, it is 5-1/4 inches (133.4 mm).
4. Distance from disc pack to dial indicator on center member. In this example, the distance is 8 inches (203.2 mm).

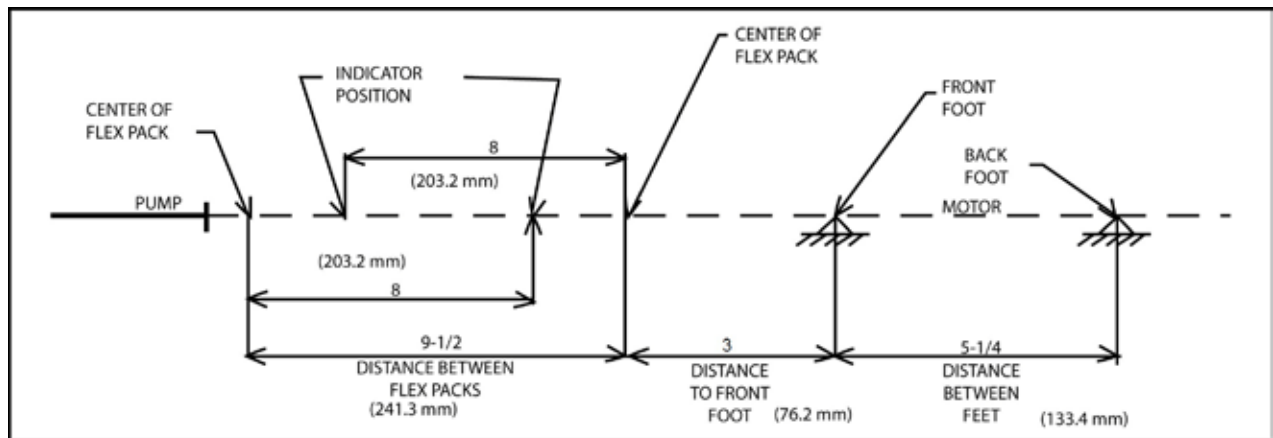


Figure 5.7 Across the disc pack alignment graphical analysis example.

The next step is to determine indicator sag. Set up your bracket arrangement on a pipe. Set the indicator at '0' on top. Roll set up until indicator is at the bottom of pipe. It will read negative. In this example, it was found to be -0.004 inch (-0.102 mm).

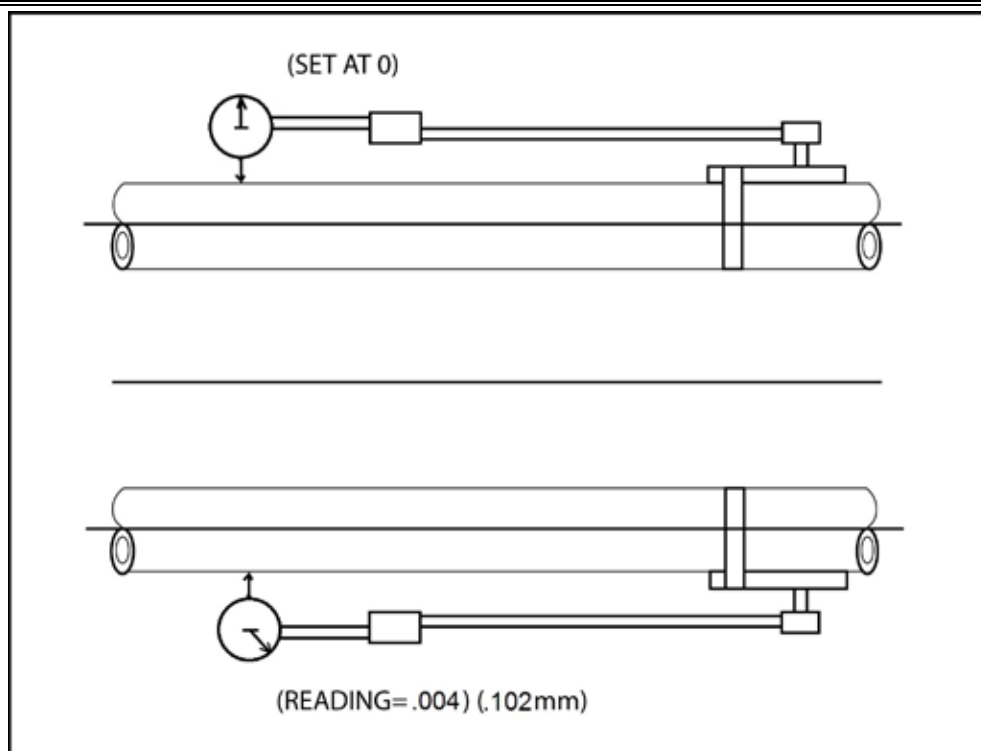


Figure 5.8 Indicator sag in across the disc pack alignment analysis example.

With the indicator bracket attached to the pump hub, reading out the center member a convenient distance, (in this example 8 inches [203.2 mm] was used) rotate the unit in 90° increments and take readings.

Bottom reading is then corrected for indicator sag. The indicator sag in the example was determined to be -0.004 inch (-0.102 mm). The -0.004 inch (-0.102 mm) was subtracted from -0.025 inch (-0.635 mm) indicator reading to give an actual of -0.020 inch (-0.508 mm) reading.

As this is a TIR (Total Indicator Reading) it is two times the actual center member center line location relative to the pump shaft extension or $-0.020 \text{ inch} (-0.508 \text{ mm}) / 2 \text{ inches} (50.8 \text{ mm}) = -0.010 \text{ inch} (0.254 \text{ mm})$. (What we are trying to do here is to determine the angle the center member makes with respect to the pump shaft.)

A plus reading at the bottom indicates that the center member tips down as it extends away from the pump. Using a scale of one small division on the graph equals 0.001 inch (0.0254 mm); plot the 0.010 inch (0.254 mm) as shown in the example.

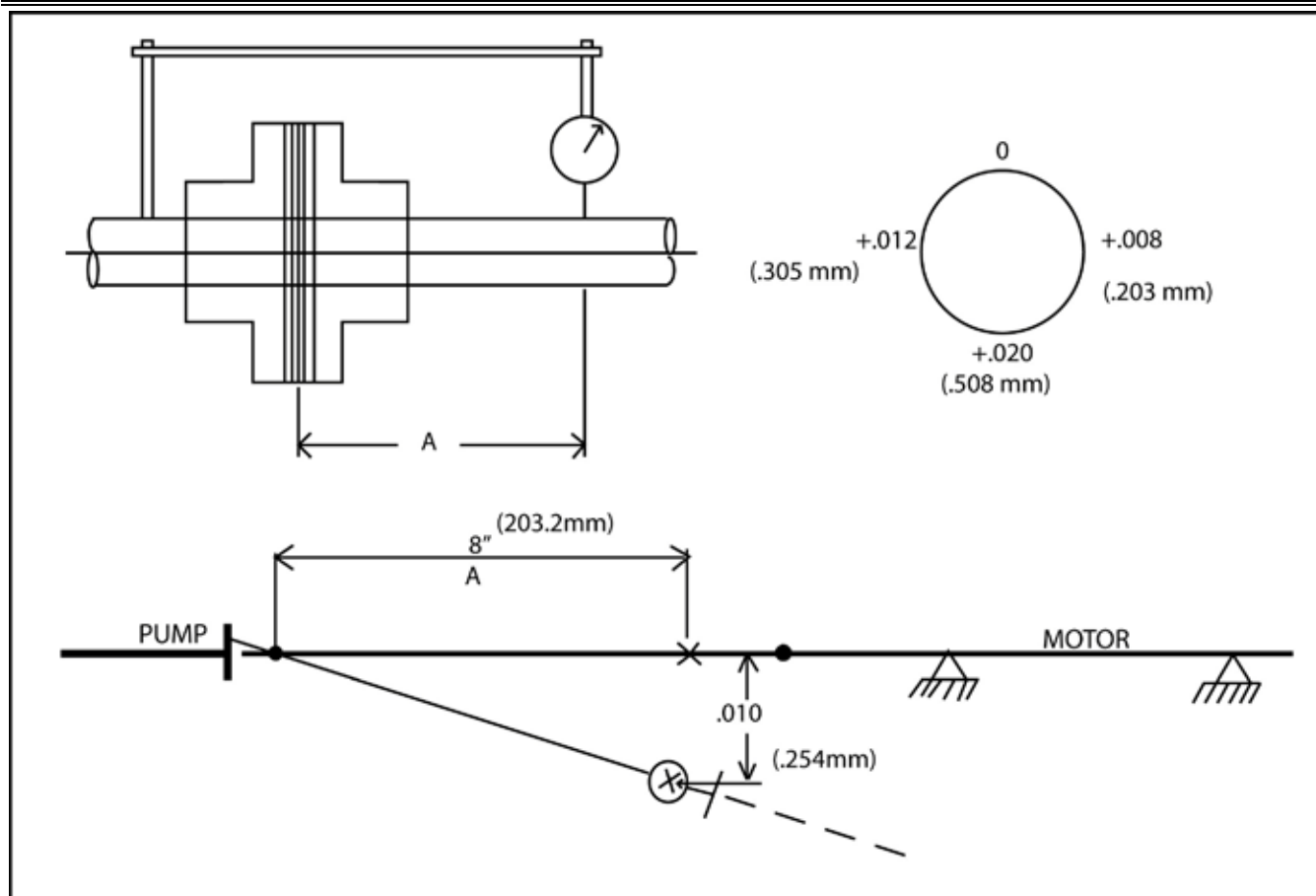


Figure 5.9 Plot of the plus reading in the across the disc pack alignment analysis example.

Now with the indicator bracket attached to the motor hub reading out on the center member, rotate the unit in 90° increments and take readings.

Bottom reading is corrected for indicator sag: ± 0.008 inch (± 0.203 mm) $- 0.004$ inch (0.102 mm) = $+0.012$ inch ($+0.309$ mm). This is TIR so actual is $+0.006$ inch ($+0.152$ mm). (What we are trying to do here is determine the angle the center member makes with respect to the motor shaft.)

The minus reading on the bottom indicates that the center member tips up as it extends away from the motor. Using a scale of one small division on the graph equals 0.001 inch (0.025 mm), plot the 0.006 inch (0.192 mm) as shown on the example.

The motor shaft can now be drawn in because two points along it have been defined: 1. Center of the flex element. 2. The point just plotted 0.006 inch (0.152 mm) below center member. The shimming requirements can now be read off the plot where the motor shaft intersects the planes of the motor feet.

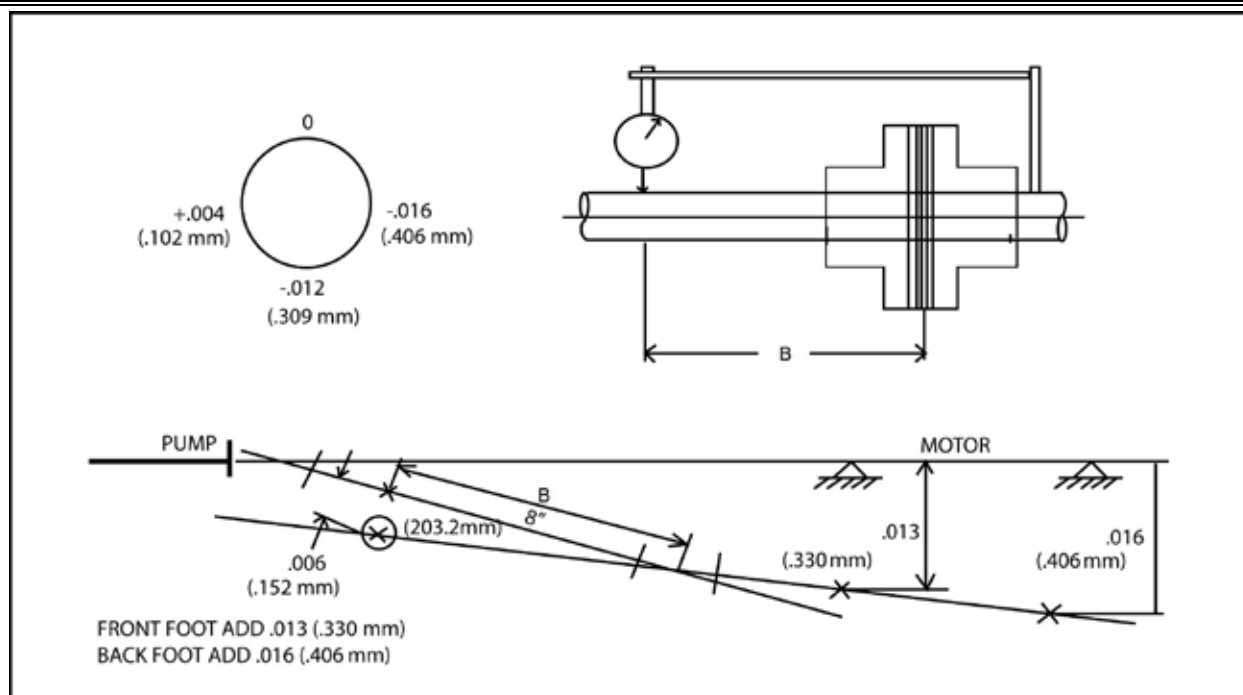


Figure 5.10 Plotting the motor in the across the disc pack alignment analysis example.

In this example, the motor should be shimmed up 0.013 inch (0.330 mm) under front feet and shimmed up 0.016 inch (0.406 mm) under back feet.

This solution can also be done by use of a pre-programmed, calculator for faster results.

For the horizontal (side to side) results, the same procedure is used. Algebraically subtract the side to side readings. Indicator sag can be ignored as it cancels out. Plot these readings and the results can be read off the graph.

SECTION SIX - LUBRICATION

6.1 OIL RING LUBRICATION

6.1.1 Recommended Lubricant

The recommended bearing bracket oil is ISO VG 68 non-detergent oil. Turbine quality oil is preferred. This oil may be used during break-in and normal operation.

6.1.2. Method of Application

Customer must fill bearing bracket before startup. The bearing bracket is supplied with a sight glass and a constant level oiler. Fill the bearing bracket with oil according to the quantities specified in next section.

Start pouring oil into the bearing housing through the breather connection located at the top of the bearing housing, leaving an amount equal to the capacity of constant level oiler bottle apart. Place the breather back on its position. To finish this process, remove the constant level oiler bottle, fill it and place it back on its position. The correct level is observed between the low and high marks on oil sight glass.

Adjust the oil in accordance with directions enclosed within the oiler glass to maintain the oil at the sight glass level mark.



- Oil level should be determined by using sight glass in bearing bracket. Oil level in constant level oiler does not correspond to oil level in bearing bracket.



- Ruhrpumpen takes every precaution during our assembly process and subsequent final assembly audits to ensure no Bearing Housing oil leaks exist prior to shipment. Oil can leak past the labyrinth seal in an “overfill” condition. Refer to the filling instructions for additional information

6.1.3. Quantity

The combined quantity of initial fill for bearing bracket and oiler is:

- (a) For Bearing Bracket Size 35, 0.32 U.S. gallons (1.2 L) for the following pump sizes:

3 x 1.5 x 7	4 x 3 x 8	6 x 4 x 10
3 x 2 x 7	6 x 4 x 8.5	3 x 1 x 11

4 x 3 x 7	3 x 1.5 x 9	3 x 1.5 x 11
6 x 4 x 7	4 x 2 x 9	3 x 2 x 11
3 x 1.5 x 7.5	6 x 3 x 9	4 x 3 x 11
4 x 3 x 7.5	6 x 4 x 9	3 x 1.5 x 11.5
4 x 4 x 7.5	3 x 1 x 9.5	4 x 2 x 11.5
2 x 1 x 8	3 x 1 x 10	3 x 1 x 12
3 x 1.5 x 8	3 x 1.5 x 10	4 x 1.5 x 12

(b) For Bearing Bracket Size 55, 0.40 U.S. gallons (1.5 L) for the following pump sizes:

6 x 6 x 9	6 x 4 x 13	6 x 3 x 16
8 x 6 x 10.5	4 x 2 x 14	6 x 4 x 16
6 x 4 x 11	6 x 4 x 14	10 x 8 x 16
6 x 6 x 11	8 x 6 x 14	4 x 2 x 17
8 x 8 x 1	8 x 8 x 14	10 x 8 x 17
6 x 4 x 11.5	10 x 10 x 14	6 x 3 x 19
6 x 4 x 12	4 x 2 x 14.5	6 x 4 x 19
6 x 6 x 12	4 x 2 x 15	6 x 4 x 21
8 x 8 x 12	8 x 6 x 15	8 x 6 x 21
4 x 3 x 12.5	6 x 2 x 16	

(c) For Bearing Bracket Size 75, 0.98 U.S. gallons (3.7 L) for the following pump sizes:

8 x 8 x 15	10 x 8 x 19	12 x 8 x 22
8 x 6 x 16	12 x 10 x 20	6 x 4 x 26
8 x 6 x 17	10 x 8 x 21	10 x 6 x 26
10 x 8 x 18	8 x 4 x 22	10 x 8 x 26

10 x 10 x 18	8 x 6 x 22	
--------------	------------	--

(d) For Bearing Bracket Size 90, 1.37 U.S. gallons (5.2 L) for the following pump sizes:

14 x 12 x 22	12 x 10 x 26	14 x 12 x 27
14 x 12 x 23	12 x 8 x 27	

Additional oil consumption, under normal operating conditions, is replenished by the constant level oiler.

6.1.4 Maintenance

Once every eight hours of pump operation, perform visual inspection of oil and oil level. Oil replenishment should not be required between changes.

Oil in bearing bracket should be changed every six months.

1. Drain bearing bracket through drain location identified on General Arrangement.
2. Flush bearing housing with clean lightweight oil (e.g. ATF).
3. Reinstall drain plug and refill bearing bracket.



- If it is suspected that bearings have been exposed to dirt or moisture, thoroughly clean the bearings and housing with a solvent and air-dry the parts before adding lubricant. Disassembly, inspection, cleaning, and reassembly procedures are provided in SECTION EIGHT - MAINTENANCE.

6.2 PURE OIL MIST-DRY SUMP



- When pure oil lubrication is supplied, the oil mist is the only lubricant provided.



- The oil mist generator must be running before starting the unit.

Basic oil-mist generating system should include the following:

1. An airline filter water separator to assure a clean air supply to oil-mist generator.

2. An air pressure regulator to control the oil-mist generator atomizing air pressure.
 3. An oil-mist generator which includes a venturi nozzle, oil lift tube, reservoir and oil flow adjustment screw.
 4. Mist distribution manifold to convey the oil-mist application fittings.
 5. Spray application fitting to meter and convert the oil-mist at each lubrication point.
- Recommended Oil: ISO VG 68 Non-Detergent Oil suitable for oil misting. (Refer to instructions with Oil Mist Generator.)
 - Air/Oil Ratio should be 0.40 cubic inches/hour/cfm (231.5 cc/hr/m³/min)
 - Type of Oil Mist Fitting: Spray type

Provide oil mist through the oil mist inlet as indicated on the General Arrangement.

Oil mist should be vented out thru the vent as indicated on the General Arrangement. (When pump is idle and mist generator is on, a mist should be visible exiting the vents. When pump is running, the windage associated with the shaft, bearing, and coupling makes it difficult to see the mist.)

Maintenance:

- Periodically inspect the sediment bottle underneath the bearing housing. (Drain as required.)
- If bearing housing is dismantled, flush bearing housing with clean lightweight oil (e.g. ATF).
- Be certain bearings have a light coating of oil before startup.

6.3 PURGE OIL MIST-WET SUMP



- When purge oil lubrication is supplied, the oil mist is used to maintain a positive pressure in the bearing housing to keep contaminants from entering the bearing housing.



- The primary lubrication is by ring oil.

All the steps outlined in SECTION 6.1 - OIL RING LUBRICATION apply, along with the following additional items.

Basic Oil-Mist generating system should include the following:

1. An airline filter-water separator to assure a clean air supply to oil-mist generator.
2. An air pressure regulator to control the oil-mist generator atomizing air pressure.
3. An oil-mist generator which includes a venturi nozzle, oil lift tube, reservoir and oil flow adjustment screw.
4. Mist distribution manifold to convey the oil-mist application fittings.
5. Spray application fitting to meter and convert the oil-mist at each lubrication point.

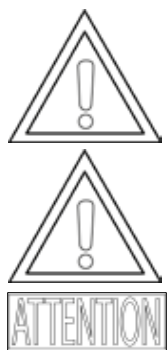
Provide oil mist through the oil mist inlet as indicated on the General Arrangement. Oil mist can be vented out thru the vent as indicated on the General Arrangement; however, if the intent is to maintain positive pressure in the bearing housing then no venting is needed.

- Recommended Oil: ISO VG 68 non-detergent oil suitable for oil misting. (Refer to instructions with oil mist generator.)
- Air/Oil Ratio should be 0.40 cubic inches/hour/cfm (231.5 cc/hr/m³/min)
- Type of oil mist fitting: Spray type

Note: Bearing housing will naturally vent through the labyrinths in the deflectors.

6.4 OIL CHANGE

The first oil change should be carried out three weeks after commissioning; all further oil changes take place every six months.



- Only change the oil when the machine is switched off.
- The drained oil is hot, and can cause severe burns.
- Remember that oil level should be determined by using sight glass in bearing bracket. Oil level in constant level oiler does not correspond to oil level in bearing bracket.

Refer to SECTION 6.1.1 - Recommended Lubricant for recommended oil types and to SECTION 6.1.3 - Quantity to ensure the proper quantity according to the bearing bracket size of your pump.

The oil change should be carried out as follows:

1. Switch the drive motor off.
2. Drain the oil out and clean the bearing housing with a suitable cleaning liquid. Flushing the bearing housing with clean lightweight oil is possible (e.g. ATF).
3. Remove the breather connection located at the top of the bearing housing and pour the oil, leaving and amount equal to the constant level bottle apart. Place the breather connection back on its position.
4. Remove the tank of the constant level oiler, fill with the remaining oil and put it back into position (See Figure 6.1).
5. The level at the oil sight glass should be between the low and high level marks. The constant level oiler bottle will have an initial level of approximately two thirds when reaching the steady state.

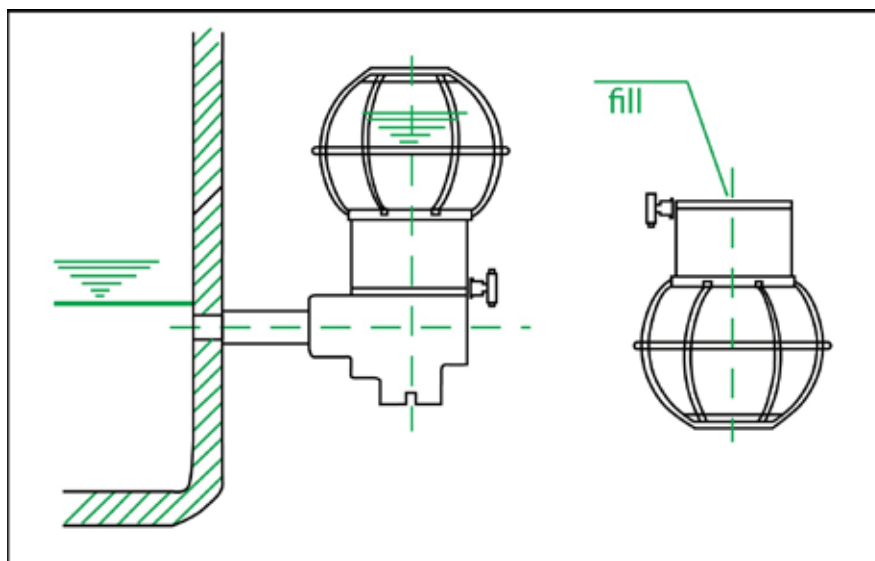


Figure 6.1 Constant level oiler.

SECTION SEVEN - OPERATION

7.1 PRIMING

Pumps handling hot ($>500\text{ }^{\circ}\text{F}$, $>260\text{ }^{\circ}\text{C}$) fluids must be gradually preheated to operating temperature. The most common method used for warming a pump, or maintaining a standby pump in a warm condition, is the use of a warming line and orifice, thus circulating the hot pumpage through the idle pump.



- It is recommended that the pump be warmed at the rate of $100\text{ }^{\circ}\text{F}$ ($55\text{ }^{\circ}\text{C}$) rise per hour for normal warming, or $268\text{ }^{\circ}\text{F}$ ($149\text{ }^{\circ}\text{C}$) rise per hour for emergency warming.



- It is recommended that the idle pump temperature be maintained within $36\text{ }^{\circ}\text{F}$ ($20\text{ }^{\circ}\text{C}$) of the system operating temperature.

Circulation can be easily accomplished by guiding a small amount of flow from the discharge side of the system beyond the check valve via a multiple breakdown orifice into the bottom of the pump case. The hot liquid will then pass through the case and out the suction and return to some low pressure point in the system. In many cases, the pump drain line is used for the warming connection.

Note: Many variations are possible and one that is compatible with the customer's particular installation should be considered.

7.2 STARTUP



- Every time before the pump is started up the safety devices must be mounted and fastened.



- In order to avoid risks of injury or damage, all pump units must be equipped with emergency-stop devices.



- For operation of electrical drives, control systems and their cable routes, the safety instructions issued by their manufacturers must be observed.

The startup procedure is as follows:

1. Before starting the pump, check the security of all bolting, piping, and wiring.
2. Check all gauges, valves and instruments for proper working order.
3. Check all equipment for proper lubrication and correct rotation.
4. Open and look through the oil fill/breather (refer to General Arrangement) to verify that the oil rings are in their grooves (oil ring and purge mist lubrication only).
5. Verify that the discharge valve is closed.
6. Open the suction valve.
7. Open discharge valve and allow pump to fill with fluid (pump is self-venting).
8. Keep the valves open approximately 60 seconds to ensure that pump is completely full of fluid.
9. Close discharge valve.
10. Uncouple the driver and the pump.
11. Start, and **IMMEDIATELY STOP**, the driver and observe the rotation of the shaft.
12. Correct rotation should be in direction of rotation arrow.



- If shaft rotation is incorrect, consult driver manufacturer's instructions in order to change rotation.

13. Priming accomplished and correct shaft rotation established, the pump is ready for continued operation.
14. Securely couple the driver and the pump, and ensure the discharge valve is open to approximately $\frac{1}{4}$ fully open.
15. Start driver again, and completely open the discharge valve **IMMEDIATELY** when the operating speed has been reached.



- Danger: Do not allow discharge valve to remain closed for any length of time. Pumped fluid temperature will rise excessively causing damage to pump.

7.3 OPERATING CHECK

During the initial operating hours, the pump should be monitored constantly. It is thus possible to detect irregularities immediately and to take appropriate measures for their elimination (See SECTION ELEVEN - TROUBLESHOOTING CHART).

To monitor flow, pressure, temperature, and lubrication, regular visual inspection and monitoring is advisable and/or necessary during operation.

Ruhrpumpen recommends checking the pump constantly at regular intervals in order to detect problems early, in case they arise.

The operational check routine must include minimum the following points:



- Beware of freely rotating parts, when the pump is in operation there is a high risk of injury.
- Check at regular intervals that the safety equipment is sound and is arranged and fastened according to the regulations, and energized where applicable.
- Check the security of all bolting, piping, and wiring.
- Check all gauges, valves and instruments for proper working order
- Check all equipment for proper lubrication and correct rotation.
- Check the oil level and validate that the correct oil grade is installed.
- Open and look through the oil fill/breather (refer to General Arrangement) to verify that the oil rings are in their grooves (oil ring and purge mist lubrication only) and are picking up oil.
- Check the temperature of the bearing bracket surface. It should not exceed 185 °F (85 °C).
- Check that the pumping unit is running quietly and without vibrating.



- Unusual or too loud noises point towards a possible fault.
- Monitor the power consumption of the drive motor. Low or excessive power consumption indicates a possible fault.
- Check the sealing system:
 - a. Refer to the seal manufacturer for his estimate of maximum acceptable leakage rate, as this will depend on application, design, location and the sealed liquid characteristics
 - b. If leakage excessive, switch the pump off as quickly as possible, isolate the pump by closing the discharge and suction valves or using some other approved method designated as safe for your system, and check the rotating seal ring and the stationary seal ring.



- If the sealing system of the mechanical seal fails, the pump must be taken out of operation immediately.



- The pump may only be operated under the minimum operating range for short periods. The minimum pump flow is given in the characteristic line.

7.4 DOWELING

When the pump has reached operating temperature and pressure,

1. Stop pump.
2. Check alignment and reset the equipment, if required.
3. Dowel the pump.
4. Dowel the driver.
5. Start the pump as defined in SECTION 7.2 - STARTUP.

7.5 STOPPING

1. Throttle pump discharge to minimum flow.



- Warning: do not close suction valve, this will cause the pump to run dry.

2. Turn the power off to the driver.
3. Close the pump discharge valve
4. Observe the run - down of the pump until full stop.



- If the rotor is jerky or suddenly stops, there is a danger that the rotor has become blocked. The pump must be opened and all running clearances checked.

5. Close the suction valve when the pump shaft stops rotating as the pump must be isolated before examination and made safe.



- Do not close the suction valve until the pump has come to a full stop, as it may cause the pump to run dry.

6. Ensure the drive motor cannot be unintentionally turned on.
7. Ensure the shut-off devices in the suction and pressure pipes cannot be unintentionally opened.
8. Drain the pump and the auxiliary piping.



- If the outside temperature is below 32 °F (0 °C), all cooling chambers must be emptied, and all seal system cooling coils must be drained.

7.6 SHORT-TERM SHUTDOWN

If the pump has switched off correctly and has not suddenly come to a halt, it may be re-started without the need to take any special measures.

If the pump comes to a sudden halt, or if the pump was switched off because of a possible danger, it must be checked for damage.

7.7 LONG-TERM SHUTDOWN

1. Follow the stopping procedure described in SECTION 7.5 - STOPPING.
2. Disconnect the vent filter and seal openings on the bearing housing to lessen the exchange of air.
3. While the unit is idle:
 - a. If the plant is in an operational state, warm up and start the unit at monthly intervals (see SECTION 7.2 - STARTUP for details).
 - b. If the plant is not in an operational state, turn the unit over by hand a couple of times at monthly intervals, ensuring the shaft is not returned to the same position, to allow the bearings to rest in a different position every time.
4. If there is danger of freezing, drain the pump, drain the oil from the pump bearings and all the auxiliary piping.
5. Change the oil before recommencing operation, ensuring the correct grade and the correct volume has been installed in the bearing housing (see SECTION SIX - LUBRICATION for details).

SECTION EIGHT – MAINTENANCE

To perform the maintenance of the SCE pump, no special (custom made) tools are needed.



- Before initiating maintenance procedures disconnect all power sources to the equipment and discharge any parts which may retain an electric charge. Use proper locks to avoid accidental start-up of the pump system. Failure to comply may result in severe personal injury.



- When performing the maintenance of the pump, use the safety equipment appropriate for the pumped fluid, materials, and location of the equipment, such as gloves, safety glasses, harnesses and other equipment regarded as mandatory by the plant's safety instructions.

8.1 DISASSEMBLY

1. Stop the pump. See SECTION 7.5 - STOPPING.
2. Drain all possible fluids from the pump case and bearing brackets.
3. Disconnect any auxiliary piping and wiring that could interfere with disassembly.
4. Disconnect the driver-to-pump coupling and remove coupling spacer.
5. When disassembling the pump, match mark, tag or otherwise identify all parts, and provide separate containers for small parts. Refer to the pump sectional drawing included in SECTION TEN - PARTS INFORMATION for proper identification of parts.
6. To separate pump cover from pump case, first remove the stud nuts, then use back-off screws in the taps provided to break the cover-to-case gasket joint.
7. Remove the pump cover-bearing bracket assembly by providing a chain or sling support for the assembly.



- Avoid bumping the impeller or the pump half coupling.

8. After removal, place the pump cover-bearing bracket safely on suitable horizontal supports.
9. To remove the impeller, first free and remove the cover-to-case gasket, then remove the impeller nut, set screw and nut, impeller, and key.



- Do not heat the impeller.



- Impeller nut is a right hand thread.

10. Exercise care and remove mechanical seal as follows:

- a) If seal has an outside drive collar, engage seal setter, then loosen setscrews prior to removal of assembly.
- b) Remove bearing bracket-to-cover cap screws.
- c) Slide pump cover, with seal attached, off pump shaft. Place the cover, with seal flange facing upward, on worktable.
- d) Apply protective wrap and store seal components. Refer to seal manufacturer's literature for disassembly, inspection, cleaning, and reassembly of the mechanical seal.

11. Disassemble the bearing bracket as follows:

- a) Remove pump half coupling and key. Application of heat is required for the removal and replacement of pump half coupling. Use a puller tool to remove the pump half coupling.



- Use a safe heating method and provide protection for personnel handling the heated half coupling.

- b) For fan cooled bearings only, remove self-tapping screws and remove the fan housing from bearing bracket.
- c) Remove the oil ring retainers.
- d) Before removing the outboard cover/Bearing Isolator assembly, file or deburr keyway if there are sharp corners or nicks. This is to avoid damaging the o-ring in the Bearing Isolator. Remove outboard cover cap screws and slide out the cover/Bearing Isolator assembly and gaskets.
- e) Pump shaft can only be removed in one direction. Press pump shaft from impeller end through the bearing bracket. Remove radial bearing from shaft and remove oil rings if applicable. Remove locknut and lock washer and remove thrust bearings from shaft.

8.2 INSPECTION and CLEANING

1. Thoroughly clean all parts with kerosene or equivalent and dry all parts with compressed air or a clean, lint free cloth.

2. Inspect all components for corrosion, erosion, pitting, and scoring. If required, replace with Ruhrpumpen O.E.M. genuine replacement parts.

- a. Visual check all individual parts for any damage
- b. Check the casing for wear.
- c. Check the impeller for wear.

To remove wear rings, first remove screw pins (if not welded), then either machine the wear rings off, or remove by segmenting with a diamond pointed chisel tool. Replacement wear rings are installed by a light shrink fit (see SECTION 8.3 - REASSEMBLY).

- d. Check the radial clearance for wear.
- e. Check the antifriction bearings.
- f. Check all auxiliary piping.
- g. Check for transmission elements of the coupling.
- h. Set pump shaft between lathe centers and indicate shaft run out. Shaft run out should not exceed 0.001 inch (0.0254 mm) T.I.R.

8.3 REASSEMBLY

Reassemble as follows:



- Observe the plant's safety precautions when lifting heavy components. Request help when moving or positioning them.



- Mounting of bearings should be carried out in a dry, dust free area away from metal working or other machines producing shavings and dust to avoid contamination of bearings.



- The bearings should remain in their original packaging. Once they are to be assembled in the shaft, they must be removed from their packaging, and the preservative in the outside diameter and the bore must be wiped out.

1. Place and heat the two thrust bearings in an induction heater. Turn on the heater. Continuously measure the temperature of the inner race, looking to reach 230 °F (110 °C).



- Measure the temperature continuously with an infrared thermometer,

pointing to the inner race of the bearings.



Figure 8.1 Heating the thrust bearings.

2. Position the shaft vertically (with the coupling side upward) in a press.

ATTENTION

• Cover the jaws of the press with soft material to prevent damaging the shaft.

3. Put oil in the shaft to lubricate for bearing installation and parts preservation.



Figure 8.2 Lubricating the shaft.

4. As soon as the bearings have reached the temperature of 230 °F (110 °C), place the bearings on the shaft in a back to back arrangement (the serial numbers in the outer race are in contact between the two bearings).

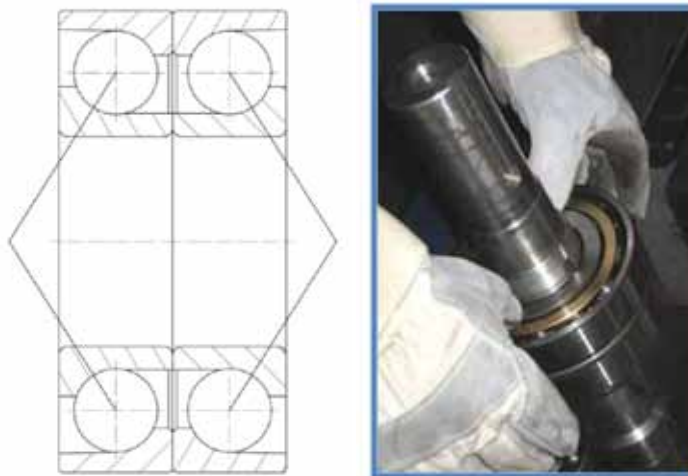


Figure 8.3 Positioning the thrust bearings.



- Wear sufficient hand protection to avoid personal injury.

5. With the locknut, but not the lock washer, tighten with a spanner wrench until snug, to ensure that there is no gap between both thrust bearings.



- Important: wait until both bearings have cooled down to room temperature before starting the next step. This cooling period is critical to ensure the final contraction of both bearings before the next adjustments.

6. Now, remove the locknut and position the lock washer so that it is in contact with the thrust bearings on the coupling side. The tab on the lock washer inner diameter must be bent to fit into the small keyway recess cut into shaft threads, to prevent rotation of the bearing locknut.



Figure 8.4 Positioning the lock washer.

7. Position the locknut with the taper towards the side of the lock washer at full-stop.



Figure 8.5 Positioning the locknut.

8. Tighten the bearing locknut as tight as possible by hand using a spanner wrench. Now, with the help of a hammer and the spanner wrench, advance the locknut at least one-eighth ($1/8$) and up to one-quarter ($1/4$) turn, to firmly snug the assembly, ensuring, at the end of the tightening process, that one of the lock washer tabs lines up with the slots in the locknut.



Figure 8.6 Tightening the locknut.

9. The tab that aligns with one of the slots is bent into the slot so it works as a lock and the locknut cannot be loosened. Use a screwdriver and a hammer.



Figure 8.7 Bending a tab of the lock washer in the locknut.

ATTENTION

- Inspection point: Inspect that the bearings are adjacent to each other, and that both are assembled seated against the shaft shoulder. The thrust bearings must be able to run in opposite directions; if one or the other cannot rotate, there is a problem with the assembly.

10. Now take the shaft out of the press and turn it over 180°, place it back in the press to reassemble the radial bearing.
11. There are two possible options depending on the type of radial bearing of your pump. Choose either a or b accordingly.
 - a. In case of radial ball bearing, place the bearing in the induction heater. Turn on the heater. Continuously measure the temperature of the inner race, looking to reach 230 °F (110 °C).

ATTENTION

- Measure the temperature continuously with an infrared thermometer, pointing to the inner race of the bearing.



Figure 8.8 Heating the radial ball bearing.

- b. In case of radial roller bearing, place only the inner race of the radial bearing in an induction heater. Turn on the heater and continuously measure the temperature of the inner race, looking to reach 230 °F (110 °C).



- Measure the temperature continuously with an infrared thermometer.



Figure 8.9 Heating the inner race of the radial roller bearing.

12. Put some oil to lubricate the shaft's radial-bearing area for bearing installation and parts preservation.



Figure 8.10 Lubrication of the shaft.

13. In this step, the procedure is also different depending on the type of radial bearing of your pump.

- a. In case of radial ball bearing, insert the oil rings at the shaft. As soon as the bearing reaches the 230 °F (110 °C) temperature, it is manually positioned in the shaft (with the serial number visible from the outside). The bearing is maintained in position until it cools down enough to stay in place (to room temperature).



Figure 8.11 Positioning the oil rings and the radial ball bearing.

- b. In case of radial roller bearing, as soon as the bearing's inner race reaches the 230 °F (110 °C) temperature, it is manually positioned in the shaft. The bearing's inner race is maintained in position until it cools down enough to stay in place (to room temperature).



Figure 8.12 Positioning the radial roller bearing's inner race.



ATTENTION

- Wear sufficient hand protection to avoid personal injury.
- Inspection point: Now that both thrust bearings and the radial bearing/radial bearing's inner race have been reassembled in the shaft, make sure that there is no gap between both thrust bearings, by holding them and trying to move them.



- Protect the bearings with oil and cling wrap plastic if you are not going to continue the assembling process immediately. When resuming the assembling process, remove this protection



Figure 8.13 Protecting the bearings if making a pause.

14. To insert the labyrinth seals into the covers, follow these steps:

- a. Lubricate the outside ring of the labyrinth seal. Lubricant supplied by isolator manufacturer or P-80 Rubber Lubricant Emulsion is recommended (grease is NOT recommended).



Figure 8.14 Lubricating the labyrinth seal.

- b. Position the labyrinth seal at the bearing cover in its correct position. (With the internal drain slot of the labyrinth seal at the 6 o'clock position of the bearing cover [you can see which side is the 6 o'clock position with the mark at the cover]).

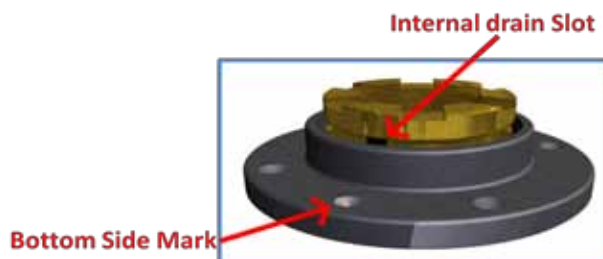


Figure 8.15. Labyrinth seal and bearing cover.

- c. Ensure the labyrinth seal is perpendicular to bore before insertion.

- d. Using a sleeve and a flat surface (hard plastic) with the help of an arbor press, insert the labyrinth seal.



Figure 8.16 Inserting the labyrinth seal.



- Do not use a hydraulic press, since the seal can be broken.

- e. Perform this procedure on both covers.



Figure 8.17 Repeating the process for each cover.

15. This step applies only for pumps with a radial roller bearing (bracket sizes 55, 75, and 90). You will need a hard plastic block. After oiling the bearing races and the bracket, position the outer race of the radial bearing (this must be aligned to ensure a correct assembly). Now, with a rubber mallet, hit (softly) the hard plastic block to insert the outer race all the way in (ensure the sleeve or block dimensions are similar to the outer race of the bearing).

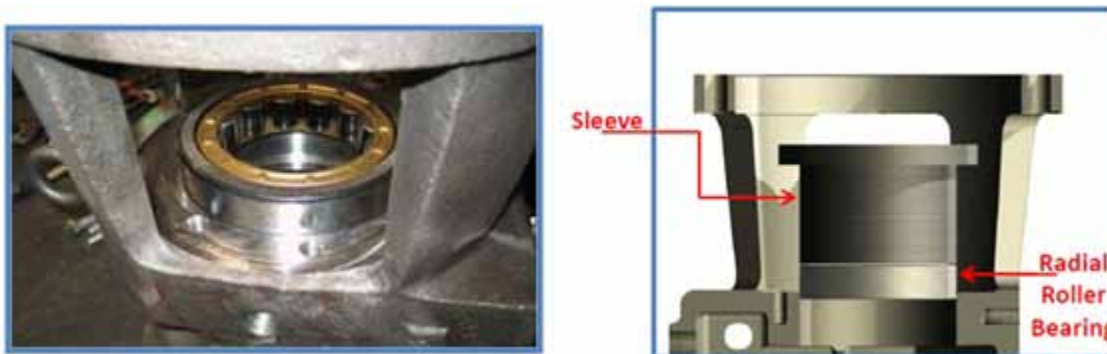


Figure 8.18 Inserting radial roller bearing for bracket sizes 55, 75 and 90.

ATTENTION

- Check visually that the outer race of the radial bearing has reached its limit within the housing.

16. Position the radial gasket at the cover, taking care of not covering the oil returns and ensuring all the slots match. Position manually the cover on the bearing bracket, ensuring the cover is rotated in the correct position.

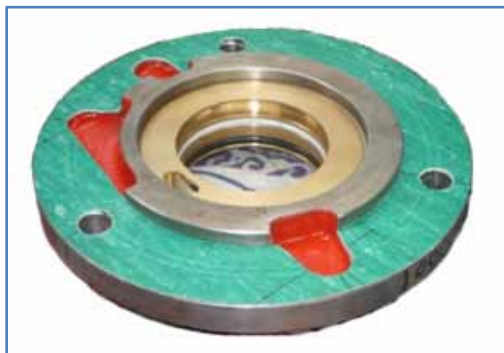


Figure 8.19 Positioning the radial gasket.

17. Position the bolts by hand (previously treated with anti seize).



Figure 8.20 Positioning the bolts manually.

18. Now tighten these bolts diagonally (crosswise) to ensure correct reassembly, using the torque values of the next table.



Figure 8.21 Tightening the bolts.

Bracket size	Bolting size	Torque values lbf-ft (N-m)
35	3/8 – 16 UNC – 2B	29 (39)
55	1/2 – 13 UNC – 2B	73 (99)
75	1/2 – 13 UNC – 2B	73 (99)
90	3/4 – 10 UNC – 2B	258 (350)



• Make sure that the gasket has not moved out or is not pinched during the process since this can cause an oil leak.

19. To position the radial cover at the bearing bracket, first put some lubricant (provided by the supplier) in the inner diameter of the radial labyrinth seal.



Figure 8.22 Positioning the radial labyrinth seal.

20. For pumps with a radial roller bearing only (bracket sizes 55, 75, and 90), the oil rings are positioned inside the bracket, concentric to the radial housing, so that they stay inside the shaft when the rotor is assembled.

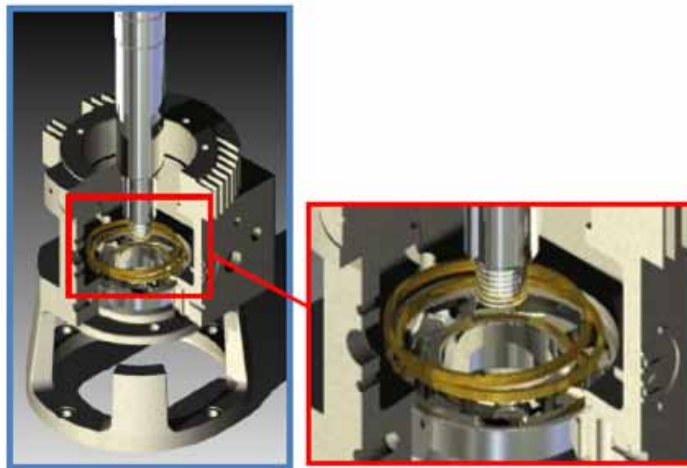


Figure 8.23 Positioning the oil rings for pumps with radial roller bearing.

21. Position the rotor assembly on the bearing bracket until thrust bearing seat against shoulder.



Figure 8.24 Positioning the rotor assembly on the bearing bracket.

22. Hit (softly) the shaft in the coupling side to ensure the correct assembly.



Figure 8.25 Hitting softly the coupling side of the shaft.

ATTENTION

- Inspection point: Check that the bearings enter evenly in the housing; the bearing should rest against the wall of the bearing bracket. After this assembly, the shaft must be able to rotate by hand; however, there is some resistance to make it turn due to the action of the labyrinth seals.

23. End float between thrust bearings and cover. This dimension is already calculated with a non-asbestos gasket (thickness 1/32 inch [0.79 mm]). The end float would be between 0.001 inches (0.0254 mm) and 0.012 inches (0.3048 mm).

- a. Use one or several hard plastic flat surfaces to hit (softly) with a rubber mallet, to ensure that the bearings are completely in contact with the shoulder of the bearing bracket.



Figure 8.26 Ensuring bearings are in contact with the shoulder of the bearing bracket.

24. To position the thrust cover at the bearing bracket, first position the thrust gasket on the bearing bracket, ensuring all the slots match.



Figure 8.27 Positioning the thrust gasket in the bearing bracket.

ATTENTION

- Do not cover the oil returns and check that all features at the bracket match.

25. Lubricate the internal diameter of the labyrinth seal. Lubricant supplied by isolator manufacturer or P-80 Rubber Lubricant Emulsion is recommended (grease is NOT recommended).



Figure 8.28 Lubricating the internal diameter of the labyrinth seal.

26. Slide cover onto the shaft, ensuring cover is rotated to the correct position (do not use a hammer).
27. Position the bolts manually, but first protect them with anti seize protection. Tighten these bolts diagonally (crosswise) to ensure correct reassembly, using the torque values of the next table.



Figure 8.29 Protecting and ensuring correct reassembly.

Bracket size	Bolting size	Torque values lbf-ft (N-m)
35	3/8 – 16 UNC – 2B	29 (39)
55	1/2 – 13 UNC – 2B	73 (99)
75	1/2 – 13 UNC – 2B	73 (99)
90	3/4 – 10 UNC – 2B	258 (350)



- Make sure that the gasket has not moved out or is not pinched during the process since this can cause an oil leakage.

28. Now, with the bearing bracket in horizontal position, through the vent hole and using a screwdriver, place the oil rings in their proper position in the shaft.

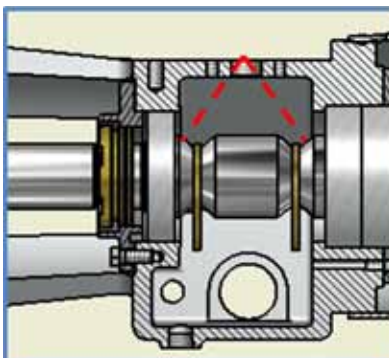


Figure 8.30 Positioning the oil rings.

29. Protect the oil ring retainers with antiseize and place them in their position until they are completely screwed in (they do not make contact with the oil rings, the separation between shaft and retainers is approximately 1/64 inch [0.3968 mm]).

Note: this photo was taken without the radial bearing and without its cover to have a clear idea of the correct position of the oil rings in the grooves of the shaft.



Figure 8.31 Positioning the oil ring retainers.

30. Position all features and plugs in the bearing bracket. Use the proper wrench to install sight glass, oiler, breather, and any other plug necessary.

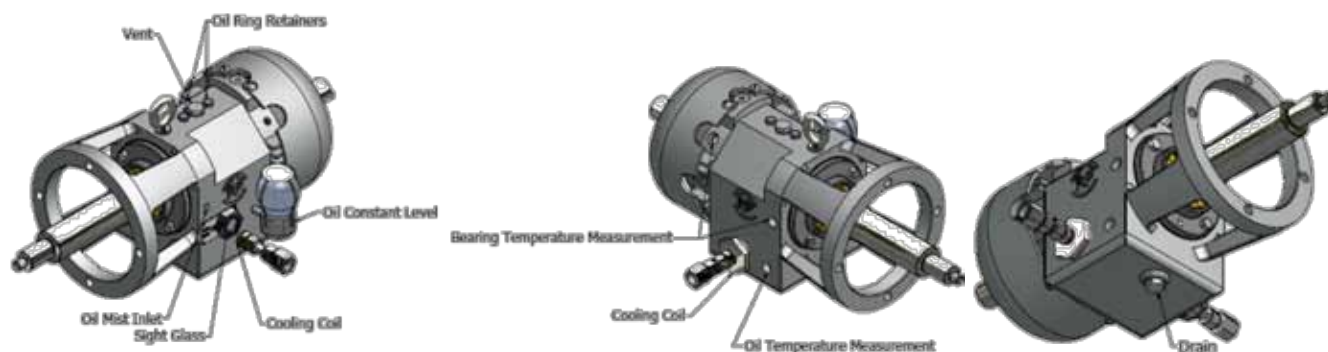


Figure 8.32 Identifying the plugs in the bearing bracket.

ATTENTION

- Apply pipe tape sealant only if it is a pass-through thread (except for the vent and the retainers).

ATTENTION

- Inspection point: Check visually that all the threads in the bearing bracket have a plug installed (no thread should remain free after this step).

31. To insert the wear ring into the casing cover, follow these steps:

- a. Place the wear ring in the freezer for 3 hours, to shrink it and facilitate the reassembly of the casing cover.

- b. Insert the wear ring completely to the shoulder on the casing cover using a rubber mallet.



Figure 8.33 Positioning the wear ring.

ATTENTION

- Insert the ring so that the shoulder rests towards the inside of the casing cover.

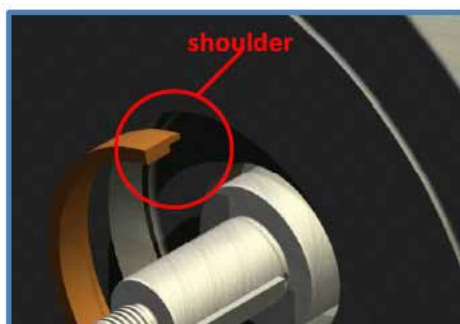


Figure 8.34 Verifying the position of the shoulder of the ring.

- c. Mark at approximately 120° three evenly spaced points in the outer diameter of the wear ring.
- d. Tack weld at these three points. The length of the tacks are ¼ inch (6.35 mm) for rings with a 4 inch diameter or under, and ½ inch (12.7 mm) for rings with a diameter over 4 inches.
- e. The weld points are polished to give them a finish.



Figure 8.35 Finish of welded points.

32. In the inner diameter of the casing cover, the wear ring that works with the shaft (throat bushing) is positioned. To do this, insert the throat bushing with the rubber mallet to the limit (it is installed by the outer side of the casing cover). Tack weld at two evenly spaced points (at 180°). The length of the tacks are ¼ inch (6.35 mm) for rings with a 4 inch diameter or under, and ½ inch (12.7 mm) for rings with a diameter over 4 inches. The weld points are polished to give them a finish.



Figure 8.36 Positioning holes at 180°.

ATTENTION

• Inspection point: Check visually that the rings are assembled to their corresponding limits in the casing cover. Check that all welded points are polished.

33. To place the wear ring that works with the casing, follow these steps:
- Place the wear ring in the freezer for 3 hours, to shrink it and facilitate the reassembly of the casing cover.
 - Insert it in its position (to the limit) with a rubber mallet.



Figure 8.37 Positioning the wear ring.

ATTENTION

• Insert the ring so that the shoulder rests towards the inside of the casing cover.

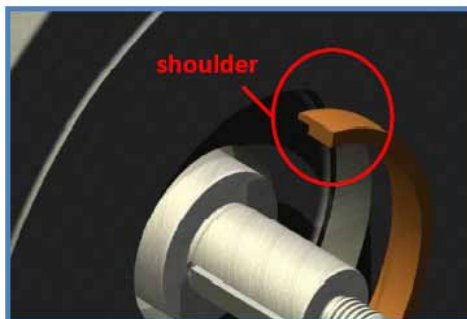


Figure 8.38 Verifying the position of the shoulder of the ring.

- c. Mark at approximately 120° three evenly spaced points in the outer diameter of the wear ring.
- d. Tack weld at these three points. The length of the tacks are $\frac{1}{4}$ inch (6.35 mm) for rings with a 4 inch diameter or under, and $\frac{1}{2}$ inch (12.7 mm) for rings with a diameter over 4 inches.
- e. The weld points are polished to give them a finish.



Figure 8.39 Finish of welded points.

ATTENTION

Inspection point: Check visually that the ring is assembled to the limit of the casing. Check that the three welded points are polished.

34. To position the wear rings of the impeller, follow these steps:

- a. Each of the wear rings of the impeller (two, one for each side) is inserted into its position (to the limit where it stops) with the rubber mallet.



Figure 8.40 Positioning the wear rings of the impeller.

- b. Mark at approximately 120° three evenly spaced points in the outer diameter of the wear ring.
- c. Tack weld at these three points. The length of the tacks are $\frac{1}{4}$ inch (6.35 mm) for rings with a 4 inch diameter or under, and $\frac{1}{2}$ inch (12.7 mm) for rings with a diameter over 4 inches.
- d. The weld points are polished to give them a finish.



Figure 8.41 Finish of welded points.



Inspection point: Check visually that each of the rings is assembled to its corresponding limit on each side of the impeller. Check that all welded points are polished.

35. To place the mechanical seal in the casing cover, first check the drawing of the mechanical seal, to be sure of assembling the seal at its correct position.



Figure 8.42 Verifying the drawing of the mechanical seal.

Now:

- a. Install the mechanical seal in the casing cover with the four studs and nuts.

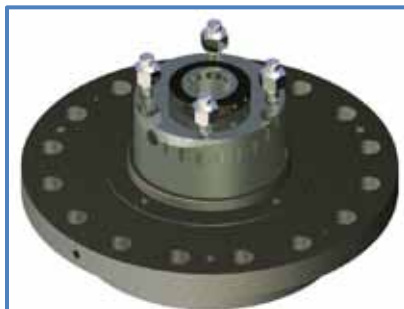


Figure 8.43 Placing the mechanical seal at the casing cover.

- b. Tighten these bolts diagonally (crosswise) to ensure correct assembly. The torque values are indicated in the next table.

Bracket size	Bolting size	Torque values lbf-ft (N-m)
35	5/8 – 11 UNC – 2B	144 (196)
55	5/8 – 11 UNC – 2B	144 (196)
75	5/8 – 11 UNC – 2B	144 (196)
90	3/4 – 10 UNC – 2B	258 (350)



• Inspection point: The shaft must be able to rotate without problems.

36. To assemble the bearing bracket with the casing cover, follow these steps:

- a. Lay casing cover down with bracket mounting surface up.
- b. Lift the assembly of the bearing bracket and position it over the casing cover shoulder.



Figure 8.44 Positioning the bearing bracket assembly on the casing cover.

- c. Position the bolts (previously protected with anti seize) by hand.

- d. Tighten these bolts diagonally (crosswise) to ensure the correct assembly. The torque values are indicated in the next table.

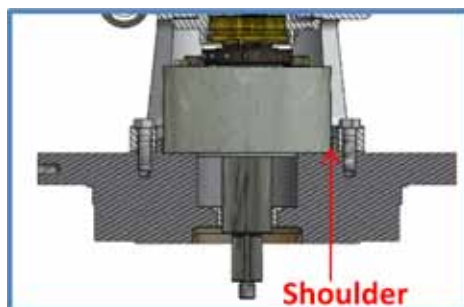


Figure 8.45 Positioning and tightening the bolts.

Bracket size	Bolting size	Torque values lbf-ft (N-m)
35	1/2 – 13 UNC – 2B	73 (99)
55	1/2 – 13 UNC – 2B	73 (99)
75	5/8 – 11 UNC – 2B	144 (196)
90	1 1/8 – 7 UNC – 2B	886 (1201)

37. To assemble the impeller on the shaft:

- Position the key in the shaft.
- Now position the impeller on the shaft until it stops on the shoulder.

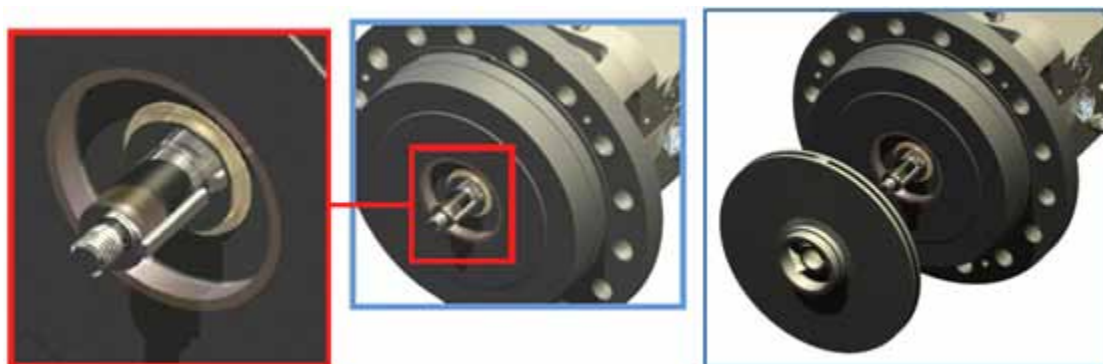


Figure 8.46 Positioning the impeller on the shaft.

ATTENTION

- Make sure that the suction of the impeller is directed towards the opposite side.

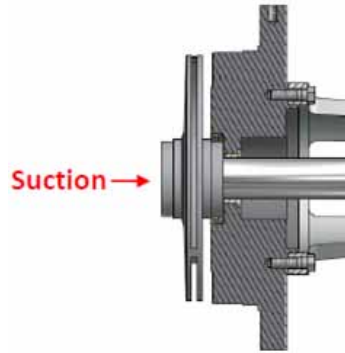


Figure 8.47 Verifying the direction of the suction.

- c. Install the impeller nut ensuring it completely seats on the impeller (a pneumatic wrench is used).
- d. Install the set screw with locktite and tighten it with an Allen key to secure the impeller nut.

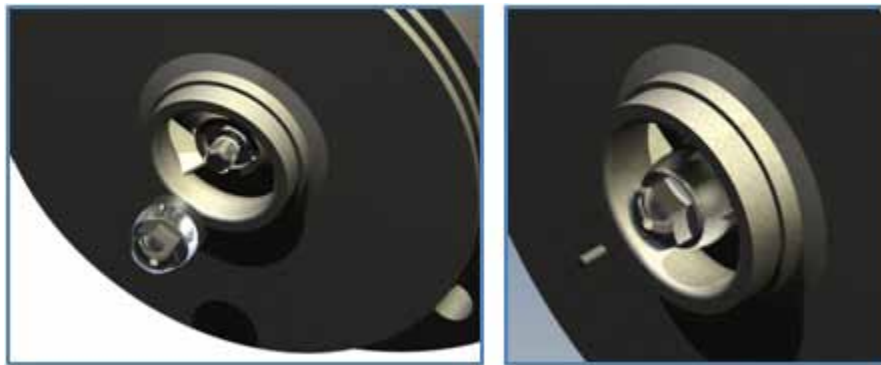


Figure 8.48 Positioning and tightening the set screw.

ATTENTION

- Inspection point: Rotate the impeller and make sure that the wear rings do not make contact.

38. To place the studs in the casing cover, follow these steps:

- a. Clean the studs and threads on the casing so they are free of foreign materials.
- b. Insert each stud (previously protected with an antiseize agent). Each one must be hand-tightened.



Figure 8.49 Positioning the studs manually.

- c. Now, use the double nut technique to insert the studs all the way in (the studs do not require torque).



Figure 8.50 Tightening the studs.

ATTENTION

- Inspection point: Check visually that studs are fastened to the limit: all of them should have approximately the same height.



Figure 8.51 Visual inspection of the studs.

39. For the assembly of the casing with the rest of the pump, follow these steps:
 - a. Metal flange cover shall be attached to protect flange surfaces.

- b. Position the casing vertically, supported over the suction.
- c. Place the casing gasket on the casing cover. Use packing grease to hold gasket in place.

ATTENTION

- The casing gasket must be changed every time the casing and the casing cover are disassembled and reassembled.



Figure 8.52 Identifying the casing gasket.

- d. Position the whole assembly vertically over the casing. Lower assembly into casing. Ensure the gasket stays in position.

ATTENTION

- Make sure that the vent of the bearing bracket and the lifting lug of the casing cover are oriented towards the discharge of the pump.

- e. Apply anti seize protection on the studs, and position all the nuts in the studs. Tighten them diagonally (crosswise) using the torque values of the next table.

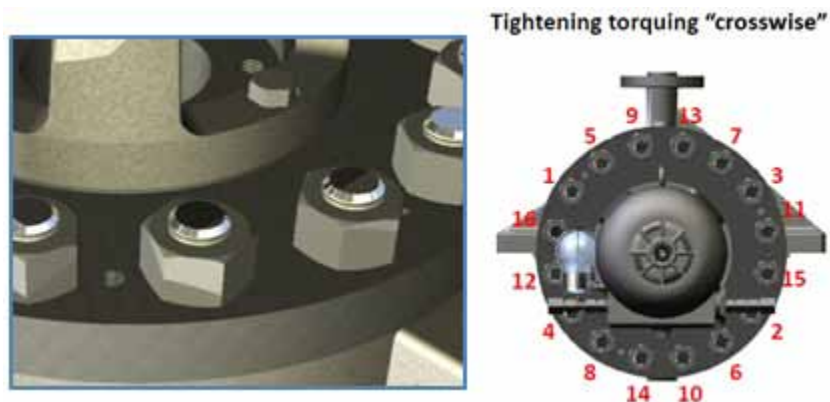


Figure 8.53 Positioning the nuts and tightening crosswise.

Bolting size	Torque values lbf-ft (N-m)
3/4 – 10 UNC – 2B	258 (350)
7/8 – 9 UNC – 2B	417 (566)
1 – 8 UNC – 2B	625 (848)
1 1/4 – 7 UNC – 2B	1 291 (1 750)
1 1/2 – 6 UNC – 2B	2 312 (3 134)

ATTENTION

- Inspection point: Rotate the shaft and make sure the wear rings do not make contact. After positioning the pump horizontally, rotate the shaft to verify again that the wear rings do not make contact.

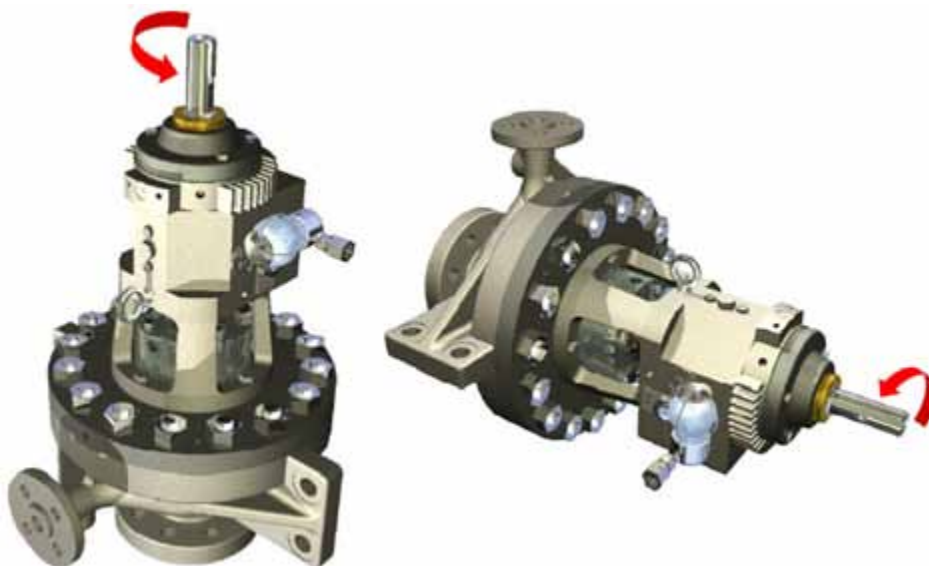


Figure 8.54 Checking the rotation of the shaft.

40. Now to assemble the fan and the fan guard (if applicable), follow these steps:

- a. Insert the fan on the shaft. Secure to the shaft using set screws. Ensure at least a $\frac{1}{8}$ inch gap in between.

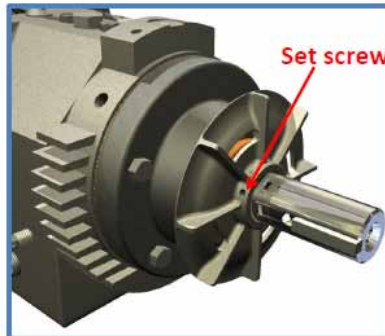


Figure 8.55 Tightening the set screw.

- b. Now position fan guard, and align the holes to the bracket.
- c. Once aligned the four holes to screw it, tighten these screws to secure it to the bearing bracket. This union does not require tightening torque.



Figure 8.56 Positioning and tightening the screws of the fan guard.

ATTENTION

- Inspection point: Turn the pump shaft to ensure fan does not rub on fan guard.

41. Now place all features back to the pump.

SECTION NINE - SPARE PARTS

The recommended quantities of spare parts to meet regular conditions of constant operation over a period of two years are given in the list below:

	Number of identical pumps (including reserve pumps)						
	2	3	4	5	6 and 7	8 and 9	10 and more
Spare parts	Quantity of spare parts						
Impeller	1	1	1	2	2	3	30%
Casing wear ring, impeller ring	2	2	2	3	3	4	50%
Shaft with fitting key and shaft screws or nuts.	1	1	2	2	2	3	30%
Bearing	1	1	2	2	3	4	50%
Bearing bracket complete with shaft, bearings, etc.	-	-	-	-	-	1	2
Seals for pump casing (Sets)	4	6	8	8	9	12	150%
Other seals (Sets)	4	6	8	8	9	10	100%
Repair Kit for mechanical seal	1	1	2	2	2	3	30%
Round section joint ring	2	3	6	8	8	10	150%

The spare parts should be available from the time of first operation.

Spare parts taken out and used must be replaced as soon as possible.

Please give the following details when ordering:

- Order No. of the pump
- Type of pump and size
- Identity number from the list of spare parts
- Part number from the sectional drawing
- Quantity

Material Storage of spare parts

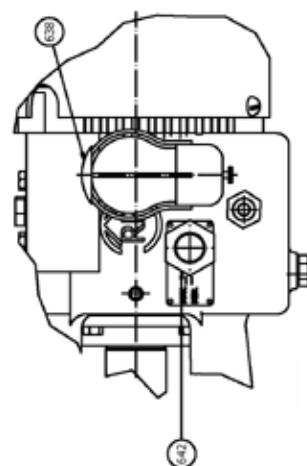
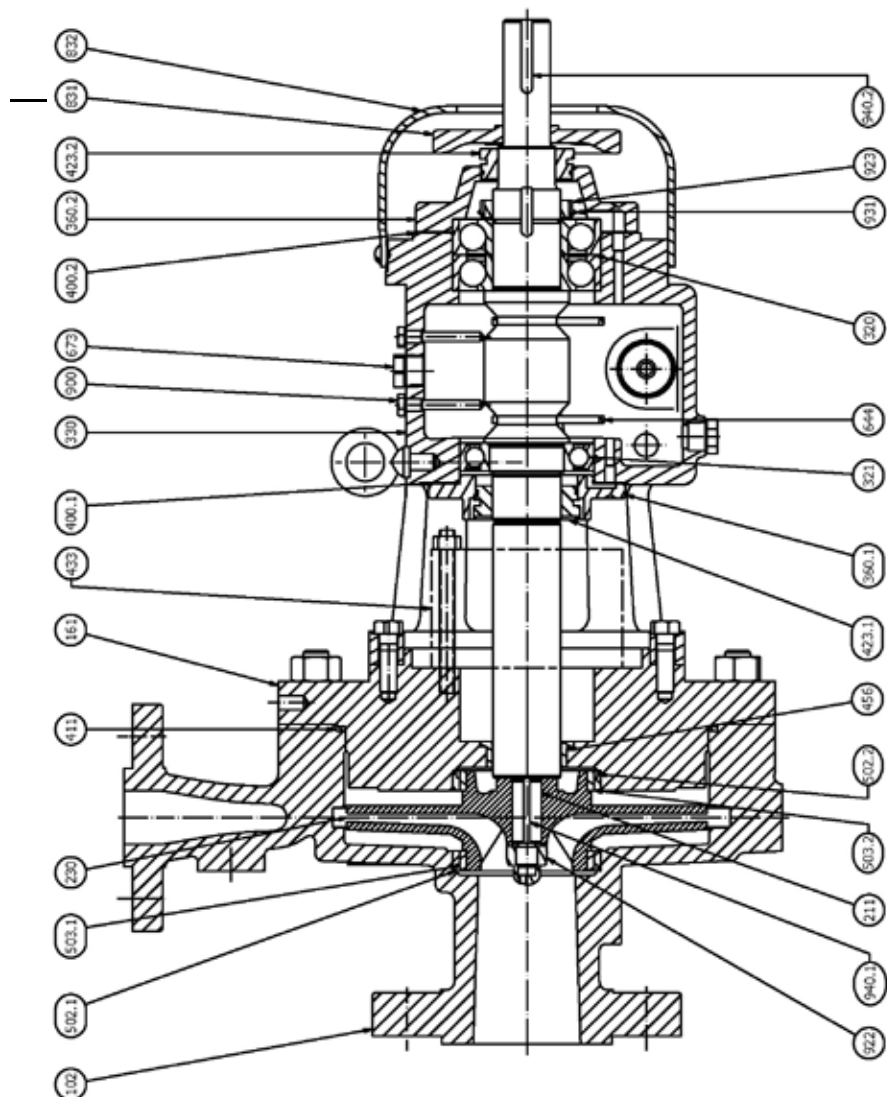
- Store the spare parts in their original packaging.

- Store in a dry place, preferably at a constant temperature.
- Check the spare parts and the state of the packaging every 6 months for signs of corrosion.
- Repair any damage or sign of corrosion with anticorrosive agents.

SECTION TEN - PARTS INFORMATION

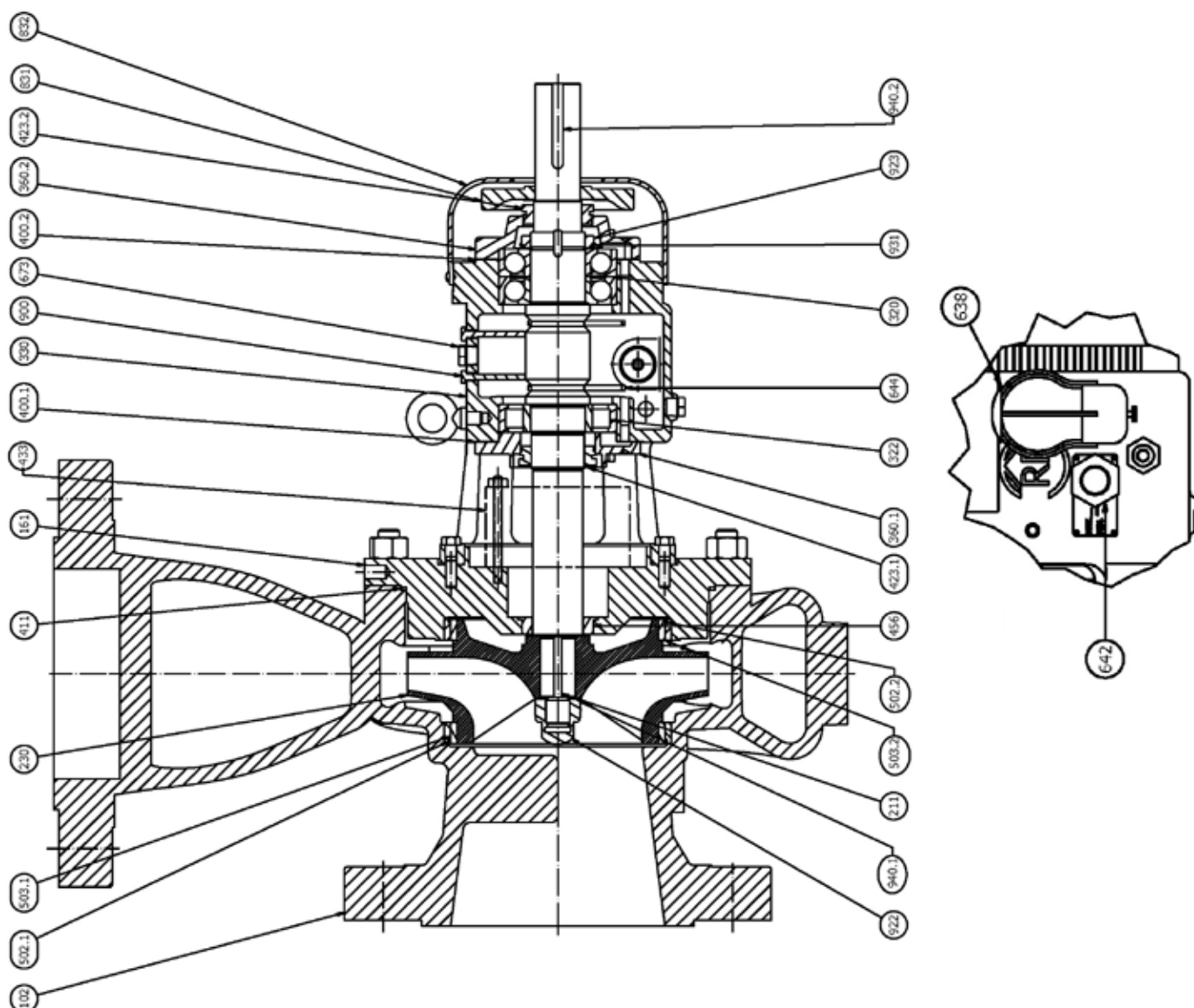
10.1 PUMP SECTIONAL DRAWING AND PARTS LISTING – BEARING BRACKET SIZE 35

PARTS LIST		
ITEM	QTY	DESCRIPTION
102	1	VOLUTE CASING
161	1	CASING COVER
211	1	PUMP SHAFT
230	1	IMPELLER
320	2	ANTI-FRICTION BEARING
321	1	RADIAL BALL BEARING
330	1	BEARING BRACKET
360.1	1	BEARING COVER
360.2	1	BEARING COVER
400.1	1	GASKET
400.2	1	GASKET
411	1	JOINT RING
423.1	1	LABYRINTH SEAL
423.2	1	LABYRINTH SEAL
433	1	MECHANICAL SEAL
456	1	STUFFING BOX NECK BUSH
502.1	1	CASING WEAR RING (EYE SIDE)
502.2	1	CASING WEAR RING (HUB SIDE)
503.1	1	IMPELLER RING (EYE SIDE)
503.2	1	IMPELLER RING (HUB SIDE)
638	1	CONSTANT LEVEL OILER
642	1	OIL LEVEL SIGHT GLASS
644	2	OIL RING
673	1	VENT FILTER
831	1	FAN
832	1	FAN HOOD
900	2	RETAINER SCREW
922	1	IMPELLER NUT
923	1	BEARING NUT
931	1	LOCKWASHER
940.1	1	KEY
940.2	1	KEY



10.2 PUMP SECTIONAL DRAWING AND PARTS LISTING – BEARING BRACKET SIZES 55, 75, AND 90

PARTS LIST		
ITEM	QTY	DESCRIPTION
102	1	VOLUTE CASING
161	1	CASING COVER
211	1	PUMP SHAFT
230	1	IMPELLER
320	2	ANTI-FRICTION BEARING
322	1	RADIAL ROLLER BEARING
330	1	BEARING BRACKET
360.1	1	BEARING COVER
360.2	1	BEARING COVER
400.1	1	GASKET
400.2	1	GASKET
411	1	JOINT RING
423.1	1	LABYRINTH SEAL
423.2	1	LABYRINTH SEAL
433	1	MECHANICAL SEAL
456	1	STUFFING BOX NECK BUSH
502.1	1	CASING WEAR RING (EYE SIDE)
502.2	1	CASING WEAR RING (HUB SIDE)
503.1	1	IMPELLER RING (EYE SIDE)
503.2	1	IMPELLER RING (HUB SIDE)
638	1	CONSTANT LEVEL OILER
642	1	OIL LEVEL SIGHT GLASS
644	2	OIL RING
673	2	VENT FILTER
831	1	FAN
832	1	FAN HOOD
900	2	RETAINER SCREW
922	1	IMPELLER NUT
923	1	BEARING NUT
931	1	LOCKWASHER
940.1	1	KEY
940.2	1	KEY



SECTION ELEVEN - TROUBLESHOOTING CHART

TROUBLE	PROBABLE CAUSES	SUGGESTED SOLUTION
HOT BEARINGS	a. Insufficient Oil b. Contaminated Oil c. Misalignment d. Too much oil e. Pump is under tension stress f. Excessive axial thrust g. The given half-coupling spacing is not set h. Bearings are damaged	a. Add Oil. b. Drain and clean reservoir. Refill with clean oil. c. Check alignment of pump and driver. d. Drain to proper level. e. Check the piping for tension free connections f. Clean balance holes in the impeller and change the seal rings. g. Reset and give the correct spacing. h. Change damaged bearings.
LEAKAGE UNDER SHAFT SEAL	a. Shaft seal is damaged b. Pump unit is not properly aligned c. The given half-coupling spacing is not set	a. Replace damaged seal. b. Realign the pump. c. Reset and give the correct spacing.
PUMP DOES NOT DELIVER LIQUID	a. Inner pump parts are worn b. Density or viscosity of pumped fluid is not same as designed. c. The motor voltage is incorrect d. Motor runs only in two phase mode e. Pump not primed f. Speed too low g. Feed pipe or impeller plugged h. Clogged suction i. Damaged impeller j. Wrong rotation k. Pump or piping are not properly vented l. Formation of air pockets in the piping m. The counter pressure of the system is greater than the design point of the pump n. NPSHa too low	a. Change worn parts. b. Consult a Ruhrpumpen dealer. c. Apply correct voltage to the motor d. Check the cables, connections and fuses. e. Prime pump. f. Check driver input. g. Clean pipe and impeller. h. Clean out suction line. i. Replace impeller. j. Check driver rotation. k. Vent or top up. l. Install vent valve or lay piping elsewhere. m. Open discharge valve as wide as necessary to reach the operating point. n. Check the fluid level in the feed container. Open suction valve completely. Lay suction pipe elsewhere if friction losses are too big. Check for a possible filter in the feed pipe.

TROUBLE	PROBABLE CAUSES	SUGGESTED SOLUTION
CAPACITY OR DISCHARGE PRESSURE LOW	<ul style="list-style-type: none"> a. Air leaks into suction b. Speed too low c. Clogged suction d. Clogged impeller e. Damaged impeller f. Wrong rotation g. Pump or piping are not properly vented h. Feed pipe or impeller plugged i. Formation of air pockets in the piping j. Inner pump parts are worn k. Density or viscosity of pumped fluid is not same as designed. l. The motor voltage is incorrect m. Motor connected only in two-phase mode n. NPSHa too low 	<ul style="list-style-type: none"> a. Check suction line for leaks. b. Check driver and its power source. c. Clean out suction line. d. Clean impeller. e. Replace impeller. f. Check driver rotation. g. Vent or top up. h. Clean pipe and impeller. i. Install vent valve or lay piping elsewhere. j. Change worn parts. k. Consult a Ruhrpumpen dealer. l. Apply correct voltage to the motor. m. Check the cables, connections and fuses. n. Check the fluid level in the feed container. Open suction valve completely. Lay suction pipe elsewhere if friction losses are too big. Check for a possible filter in the feed pipe.
DRIVER OVERLOAD	<ul style="list-style-type: none"> a. Density or viscosity of pumped fluid is not same as designed. b. Speed too high c. Pump unit is not properly aligned d. Pump is under tension e. The motor voltage is incorrect f. Motor connected only in two-phase mode g. Bearings are damaged h. System head lower than rating 	<ul style="list-style-type: none"> a. Consult a Ruhrpumpen dealer. b. Decrease driver speed. c. Realign the pump. d. Check the piping for tension free connections. e. apply correct voltage to the motor. f. Check the cables, connections and fuses. g. Change damaged bearings. h. Check suction and discharge pressure. Set operating point with the discharge valve

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